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TELEGRAPHIC JOURNAL:

A

WEEKLY RECORD OF ELECTRICAL PROGRESS.

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TO OUR READERS.

WE this day complete the first half-yearly volume of the *Telegraphic Journal*. In the outset we expressed our determination to fairly represent every interest in telegraphy:—the company, the electrician, the engineer, the superintendent, the clerk, and the messenger, each in turn has received consideration. Where abuses have been found to exist, we have exposed them fearlessly; where vested interests have been set up against the public good, we have administered rebuke; where temporising with valuable inventions has been found to impede the due development of science, it has been denounced; and where authority has been unduly exerted, to the manifest injury of the employés of our large companies, these columns have been open to the plaints of the sufferers; but whether we have fulfilled all our promises is a matter on which we in delicacy refrain from expressing an opinion.

Twenty-five years ago Messrs. Cooke & Wheatstone established the first line of telegraph on the Great Western Railway, and so rapid has been the extension of the system that we are now enabled to announce that the capital of every kingdom of importance is in direct communication. England is in a position to correspond with the Government of her Indian empire in the brief space of three days, which time will be considerably diminished on the completion of the overland section of the Persian Gulf telegraph; and we hope in the autumn of next year to be able to record the connection of Europe with America *viâ* the Atlantic and Russo American telegraph routes. Submarine telegraphy, by which these marvellous results have been achieved, is still in its infancy. On the questions of insulation and protection of subaqueous cables, doctors disagree, but day by day knowledge of the conditions under which submarine electrical communication can be attained increases, and we purpose to keep our readers *au courant* with the latest improvements and discoveries in oceanic telegraphy. Many erroneous views still obtain on the two last-mentioned branches of the art, and our observations and experiments to determine the cause of past failures have proved that mishaps result, not so much from faults in the electrical arrangements as from defects in the mechanical construction of cables, or from the violation of conditions which must ever be observed in paying them out from vessels into the sea.

It has been our privilege within the past six months to be consulted upon the feasibility of several new projects, to examine many new inventions calculated to improve and simplify the art of electro-telegraphy, and to report numerous discoveries in electrical science. In cases where we have recognised sterling merit we have never failed to give encouragement, and to report favourably; but several contrivances have been brought under our observation, distinguished by ingenuity and originality of design, which, on examination, proved to be totally inapplicable to practical purposes. We have, therefore, been not unfrequently compelled to pronounce opinions adverse to those entertained by inventors of their appliances. This course is the only one open to journalists devoted to science by an *amour propre;* and whenever our opinion is solicited we shall preserve the same even-handed justice in determining the merits or demerits of any design submitted to our consideration as we have maintained hitherto.

Our readers will be anxious to learn something of our present position and future prospects. It was hardly to be expected that success could be achieved until we had demonstrated our earnestness, and in part realised the promises held out in our first number. Time has shown that as the *Telegraphic Journal* becomes more generally known its circulation increases. It is in contemplation to publish from time to time chapters on Applied Chemistry, Metallurgy, Meteorology, and other of the contemporary sciences, and thus to make the *Telegraphic Journal* the *vade mecum* of the student, and a work of reference to the philosopher. During our brief career an interest has been awakened among the directors and shareholders in telegraph companies—a sphere remote from our anticipations of influence—and among telegraphists on the continent and in America, which has materially enhanced the value of our journal, and rendered it a most efficient advertising medium. In our labours to achieve the present favourable results we have been materially assisted by friends and contributors in all parts of the United Kingdom. The news which we have published from time to time has been procured for our columns by the disinterested intervention of gentlemen engaged in various pursuits, to whom we take this opportunity of tendering our hearty thanks. It only remains for us to add, that the interests we seek to represent promise to rival in magnitude the most colossal undertakings of modern times, and it will be our endeavour to faithfully chronicle telegraphic progress, to watch vigilantly the development of the art, to promote as far as practicable the well-being of all persons engaged in telegraphy—in short, to make the *Telegraphic Journal* a compendium of fact, a record of scientific research, and a valuable addition to the literature of the age.

SUFFOLK-LANE, CITY, E.C.,
25th June, 1864.

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REASONS FOR AN EXCLUSIVELY TELEGRAPHIC JOURNAL.

THERE is scarcely a trade or profession but has its special organ of the press, and probably no department of Science, Art, and Manufacture which is not represented, and its interests forwarded by the same means. Where this is not the case the reasons are obvious. That such a provision is beneficial, however, is manifest from the facts of such journals having become an absolute necessity to that portion of the public whose cause and interest they advocate. On the other hand, where such special organs are wanting, it is notorious that certain bodies, trades, guilds, professions, sciences, or what not, have suffered not a little from an unnecessary seclusion and isolation.

The consequence of the discovery of a new science, or even the novel application of an old one, is not unfrequently the introduction of an enterprise, unique and unlooked for, affording scope for boundless ambition, and absorbing in its working out the labour, energy, and cares of thousands of hands, heads, and hearts, which assuredly, a few years back, never dreamed of being engaged in such an occupation.

Such now is Telegraphic Science, and the enterprise to which it has given birth. Although but a thing of yesterday it has absorbed a larger amount of capital in a shorter time than probably any other project set on foot, not excepting our great Railway undertakings. The individuals mixed up with its development, direct and indirect, may be counted by tens of thousands, many of them probably comparatively unacquainted with the mighty agent submitted, as we may say, to their manipulation; and yet this vast body remains virtually unrepresented by the press; nay, it has even lain under the imputation of failing to support a journal devoted to its interests. Assuredly there is something wrong here. A lack of patronage is not unfrequently the result of some deficiency in the persons seeking it. It is irrelevant to our present purpose, however, to inquire whether this has or has not been the case. We are satisfied that the many thousands engaged in telegraphic pursuits are prepared to support a journal conducted in an impartial spirit with talent and energy, and devoted exclusively to the interests of the large and influential class it seeks to represent.

Upon two accounts we base our claim to success, and we have no misgiving as to the result.

First, we design this to be a Telegraphic Journal *pure et simple*, to be kept intact from inroads of alien departments of electrical and other sciences, which can hardly be of interest to the bulk of those for whom we labour.

And, Secondly, we do not intend this to be so profound a scientific journal—stilted to such an unconscionable extent as to talk over the heads of the majority of our readers. Pure abstract science, and the theories which claim paternity thereto, can only be acceptable to, and find a response in the minds of a few of the large class whom it will be our privilege to address, hence while we shall be careful not to ignore the importance of these truly scientific lights of the world, and while we shall be most happy to make the Telegraphic Journal the medium of any new theory in electrical science and its adaptation to practical telegraphy, and while to this end we most cordially solicit the co-operation of these eminent gentlemen, we at the same time shall studiously avoid making these abstruse matters the predominant feature of the publication.

A small portion of our space will be devoted to the setting forth, in a popular and readable form, matters bearing on electrical and telegraphic science for the benefit of the student and the amateur; and, in order to adapt its pages to the capacities of ordinary minds, who, in all cases, form the majority of the reading public, we purpose making this journal the faithful record of all that transpires from week to week appertaining to the development of that science and enterprise whose organ it not unworthily seeks to be. By the capitalist therefore, who desires a good investment, while intent upon aiding the advance of that mighty agent—that distinctive characteristic of the latter decades of this nineteenth century which is to draw the ends of the earth together—our pages may be consulted with perfect confidence, since they will be the repertory of the all-important facts relative to the origin, progress, and standing of every company engaged in telegraphic pursuits, manufacturing and otherwise.

As a chronicle of passing events connected with this science—home, colonial, and foreign—it will be invaluable to the commercial man, no less than to the student of science, the electrician, and the engineer.

As a vehicle also for making known new inventions, improvements, and mechanical adaptations in telegraph cables, electrical instruments, &c., it will be peculiarly acceptable to the manufacturer and mechanician; while to the general public we hope to make it welcome by giving an epitome of valuable information on telegraph matters, written in such a way as cannot fail to be appreciated by those who wish to be posted up without much trouble to themselves.

We had proposed saying something specially on the advantages of a journal devoted exclusively to telegraphy and its attendant science, but we think what has already been written illustrates most forcibly that opinion. We have no wish to encroach upon the province of others. Surely there is a body sufficiently numerous engaged in the vocation we design to represent to support a journal of their own, and if so it is but reasonable they should wish such a periodical to be true to its character. We conceive that all that is required in the Telegraphic Journal is, that it should be the exponent of the science it represents, and an accurate reflex of current views, opinions, and transactions; and it could not properly be considered such if it should admit dissertations, arguments, and theories upon other sciences and subjects alien thereto. We shall better fulfil our duties in regard to telegraphy by devoting the whole of our energies and space to this subject alone in its elementary, theoretical, and what is no by means of the least importance, its commercial aspect.

The programme above indicated, if faithfully fulfilled, will leave but little space for making raids among other matters; nor are we desirous of thus presenting an incongruous medley to a class of readers, who, when they take up a telegraphic journal, expect to find its title borne out by the contents; and sure we are that the bulk of our readers are at one with us on this matter, and, indeed, it is mainly on this ground that we base our certainty of success; since a journal true to its character will recommend itself to those highly influential classes whose countenance and patronage will be the best proof of its merit, and thus render it a first-class medium for that description of support without which journalism could not exist.

PRIVATE TELEGRAPHY.

A retrospect of progress is at all times useful—a "taking stock" of our acquirements is sure to be of interest to some. There have been periods when progress has flagged, but this cannot be said of the times in which we live. Though oft repeated, not less true the phrase, "How would our fathers wonder at the sights which long familiarity has made with us quite common-place!"

The telegraph still ranks amongst the greatest wonders of the age. This is so universally allowed as not to need an argument for its enforcement; nor is it now our purpose to direct attention to the subject in its grand entirety; one single branch is all we claim regard to from our readers now—that branch is "Private Telegraphy."

A *Private Telegraph*. The union of these two expressions would have seemed absurd less than ten years ago, and why? The fact is, we have regarded telegraphs as public institutions *of necessity*. We thought it might be well enough for *companies* to have their lines, charging a certain sum for messages which they convey; we thought that even *Government* might have exclusive lines; but *private* individuals to have *their* private lines of telegraph was surely far beyond the bounds of reason. We remember when a single individual made every piece of telegraphic apparatus; others seemed to think a kind of mystery hung over them: an ignorance as great stops many individuals from having private lines.

The world of business owes a debt of gratitude to those who, throwing off the bonds of habit, felt that in possessing for their own exclusive use a line of telegraph, forming a link between their several establishments, bringing them virtually under one roof, almost under one eye, they would derive a benefit compared with which the cost would be as nothing.

Prejudice was once so strong against the use of even *public* telegraphs that we remember when a leading company employed an agent in the provinces to call attention to the value of the system, and show how useful it would be for general purposes. The public now no longer need an argument in favour of a *public* telegraph, but *private* telegraphy really needs an advocate. It ought need none, for whilst we readily accept our public lines as valuable helps to trade, as indispensable, in fact, as railroads, to private lines alone we look to meet a want which nothing else *can* meet. And yet, despite its manifest advantages, how little is the system taken up! Why are our larger towns alone to reap its benefits? Does not the country generally offer fields of promise? We feel assured that as the system spreads, so it will spread; we look upon it as a growing giant, and know that long before our children are our age its stalwart arms will circle every town, and not a house of consequence will be without a private telegraph.

We fear the public have imbibed a prejudice against our protége on grounds unfounded; the "clothes-lines" overhead are not attractive certainly, but they are not a necessary portion of a system, nor yet the "tripods" looming through the mist with hideous bend; the wires can be laid in pipes beneath the soil, under the kerb-stones possibly, and great advantage would arise from this arrangement.

Another objection to a private line—and this, we think, is based on firmer ground—is the uncertainty attendant on its action. We know a firm who, after adopting their own telegraph, at once dismissed five errand-boys, and when a breakdown happened to the line, their boys, accustomed to the work, were gone, and thus they felt a greater want than had they never trusted to their telegraph. Such causes of complaint will sometimes happen, we admit, for no machine is perfect; but much that is faulty may and will be remedied by better management; and healthy competition will go far to remedy the evils we allude to. But yet, with all the faults which now exist, the system must not, cannot die; the public will not long prefer to pay their sixpence, perhaps their shilling, for a telegram which may not ever reach its destination, or, if it does not come to grief in transit, may arrive too late for use, or possibly convey a meaning just the opposite of what was meant; they will not rather send a loitering errand-boy, or "cab it" in emergencies, and, perhaps, get "blocked" in going, when, by the possession of a private line, they have at their disposal—always at hand—upon their very desk—the means of holding conversation with their other house, and this with no more trouble than to ring a bell and call a clerk from an adjoining room. We feel assured that many firms pay yearly more for telegrams between their several establishments, with all the risk of *failure*, *error*, and *delay*, and lack the freedom, after all, of sending messages without regard to number, than it would cost them to possess a *better*, *quicker*, *private* line.

For hospitals, hotels, mines, factories, police and fire establishments, connecting stables with the house, or lodges with the servants'-hall, the nearest station with the country residence—these are a few amongst the many instances in which a private telegraph becomes invaluable.

We shall attack this subject at a future time; we leave it now, content with having drawn attention to its great importance. The public are the losers by its non-adoption, and our object is to some extent achieved if some who have hitherto held aloof should doff their prejudice, and fairly give a trial to the system.

PARLIAMENT AND THE TELEGRAPH INTEREST.

It has long been felt that the vast and increasing interest of Electro-Telegraphy is inadequately represented in the House of Commons, especially in its scientific and practical character and operations. The application of electricity to the purposes of telegraphy, although, comparatively, but of a recent date, has effected a mighty revolution in the means employed for the interchange of thought between individuals as well as nations, however distant apart, thereby rendering the Telegraph interest one of the most important in the country, not even second to the great Railway interest. We have had numerous discussions, occupying a considerable portion of the time of the House of Commons, during the last few sessions, on the various designs and contrivances suggested by scientific men, mechanicians and others for the best method of constructing iron-clad ships, heavy ordnance and small arms, and expensive and protracted experiments instituted to ascertain and determine their respective merits.

In the latter part of the year 1859 the Lords of the Committee of Privy Council for Trade caused to be appointed a committee, consisting of gentlemen well known for their scientific attainments and great practical knowledge, to enquire into "the best form for the composition and outer covering of Submarine Telegraph Cables." The committee was occupied for a considerable period in making numerous experiments, and in receiving the evidence of gentlemen conversant with the subject of telegraphy, and the report presented to Her Majesty's Government appears in the shape of a Blue Book, of some 500 folio pages.

It might have been expected that some notice of so important an enquiry would have been brought before the House of Commons, but such has not been the case. In all discussions and explanations relating to telegraphy, it has always been evident that the speakers were disinclined to express an opinion as to the merits of various forms of cables, of different sorts of insulating materials, or signal apparatus, although at the time some hundreds of thousands of pounds sterling of the public money were to be expended in the extension of telegraphic lines. The reason why so much silence prevails in the House upon so important a subject is difficult of conjecture, unless it be considered that it is so intensely scientific, and mysterious withal, as only to be approached by a few of our profoundest philosophers and mathematicians.

We sincerely trust that, at the next general election, the friends of telegraphic progress will exert themselves to return into Parliament a few energetic men, scientifically and practically acquainted with the requirements of the great and rapidly-increasing interest of Electro-Telegraphy.

MR. R. S. CULLEY'S NEW WORK.*

IT has always been a subject of regret amongst telegraph engineers and employés that we do not possess in the English language any standard work on the Electric Telegraph. Those who enter that profession have to master its details and learn its intricacies through that hard taskmaster—experience. Those who, fortunately for themselves, are proficients in foreign tongues have no difficulty in acquiring the knowledge they desire from continental sources. The literature of France and Germany teems with excellent treatises on telegraphic subjects, but England is, unfortunately, deficient in that respect. We are happy to say that the deficiency has been supplied. Mr. Culley has written a most excellent treatise. It is addressed to those who really required such a work, the practical men of telegraphy, and it possesses the additional value of being published under the sanction of the Chairman and Directors of the Electric and International Company.

The work is divided into ten parts, in which are explained, in a very plain and lucid manner, devoid of all technicalities and theoretical speculations, the laws which regulate the application of electricity to telegraphic purposes; the methods adopted to detect the presence and whereabouts of faults and defects; the practical management of apparatus, and the general construction of lines, We observe, with pleasure, that Mr. Culley has been assisted in his labours by Messrs. C. F. Varley and W. H. Preece, and, with such help, united to the author's own talent and long experience in the fields of telegraphic science, he cannot have failed to produce a work acceptable to the profession, and valuable to the general student.

He has exploded the long-received notion that the needle telegraph is the general instrument adopted in England. The Morse system is that which is now universally employed on all important lines. He says:—

> The commercial value of an instrument does not depend upon the use of the ordinary alphabets, but upon the amount of work it will turn out, and its accuracy and freedom from derangement. The Morse instrument is at present unsurpassed in these respects, and it has been found that its introduction upon a circuit previously worked by the needle system reduces error to a very considerable extent. This arises from its signals being *recorded;* they can be read calmly and without flurry, and should an error arise it can be traced to the person in fault, thus inducing a far greater sense of responsibility.

The first part is devoted to a description of the general sources of electricity, and from a perusal of this the student cannot fail to acquire a full elementary knowledge of the various means employed to generate that supple force, and the laws which regulate its action. We regret to observe that he makes use of the exploded term "intensity." All the actions of the current can be explained and its laws propounded, by the terms *electro-motive force, tension,* and *quantity.* We even object to *electro-motive force,* and are content with simply *tension* and *quantity.* In dealing with the laws of Ohm, the first term may be necessary, but in all the practical requirements of telegraphic science, tension and quantity are quite sufficient to describe all the various dynamic phases of the current. It is much to be regretted that electricians cannot arrive at some unanimous determination on this vexed point. An eminent electrician has recently made "confusion worse confounded" by introducing Green's quaint old term "*potential.*" We have, in studying different works, to find out the meaning of the terms, and particularly so when we read French and German productions. Electro-motive force, tension, potential, density, intensity, and quantity, are mixed up in indescribable confusion. Every man adopts his own reading, and considers every other man's reading wrong. It would be well if the British Association were to take this matter up with the zeal and spirit they have shown in endeavouring to arrive at some universal standard of resistance.

The descriptions of the various internal workings of the battery, and the directions as to their care and use, are invaluable and unique. The telegraph clerk and lineman would do well to study carefully this part of the work. Very little trouble is taken at present, by our great companies, to engraft their employés in the rudiments and philosophy of their occupation. They are expected to teach themselves, and no trouble is taken to select such persons for service as have shown a natural aptitude and desire to follow scientific pursuits. A telegraph clerk is left in charge of a station who has no more idea of the nature of a current than he has of the interior of the moon; and a lineman is left to the care and charge of his batteries, with a knowledge of their internal operations as profound as his notions of the metaphysical relations between man and the lower animals. The publication of Mr. Culley's work, and the dealing of the scientific portion of the subject in the style of this first part, will go a long way to remedy the evil.

Magnetism, and the connexion between magnetism and electricity, are dealt with in the second part, and simple instructions are given to perform an operation which a telegraph clerk is called upon to do more than any other, viz., that of magnetizing. Galvanometers of various kinds and shapes, electro-magnets and their doings, are detailed, and we only regret that Mr. Culley has not gone more fully into this branch of his subject. There is no doubt that those for whom this book is principally intended can acquire all the knowledge they require from elementary works, but it must be recollected that most of them have neither the opportunity nor the means to obtain such works, and a practical book ot this nature should, in reality, be a *vade mecum,* a manual in which they can obtain all the knowledge and information they desire. Its want of copiousness is the principal fault we have to find with the work, and if it reach a second edition we sincerely trust that its author will materially enlarge it.

Part III. on the resistance and the laws of the current, is, perhaps, the most valuable portion of the work to telegraphists, and it is one upon which Mr. Culley has evidently devoted much time. The way in which Ohm's laws are worked out and illustrated are particularly happy. The action of the earth, in telegraphic circuits and dynamic currents generally; its resistance, and the best form of earth-plates and contacts are examined. The part which the earth forms, whether it acts as a simple reservoir, or as an ordinary conductor, has ever been a bone of contention among electricians, and Mr. Culley, by adopting Gavarret's views, enrols himself with those who consider the earth as an ordinary conductor, and subject to all the laws of resistance and conduction.

With reference to earth-plates, he has the following valuable remarks:—

> A water or gas pipe is preferable to a plate, because of its larger surface. Care must be taken to connect to the main street gas pipe, as the joints indoors are frequently packed with white lead. It is best to use both water and gas pipes, so that, if one be under repair, the other shall complete the circuit; a well soldered connection could always be made.
>
> A narrow deep trench filled with coke, in which a copper plate, or what is better, a strip of lead, is buried, may sometimes be used, bearing in mind that the object is to expose as large a surface as possible.
>
> Plates must always be buried *flat,* and not coiled into a cylinder or spiral, and upright rather than horizontal.
>
> On connecting up a circuit of less than ten miles, it frequently happens that a permanent current appears on the instrument, arising from the earth-plates forming a battery. If an iron gas pipe be used for an earth at one end, and a lead water pipe or a buried plate of copper at the other, a current is always set up.
>
> It is necessary, then, to be careful that both earths be as nearly as possible alike, and to change one or both till the current ceases.

(*To be continued.*)

* A Handbook of Practical Telegraphy. By R. S. CULLEY, Telegraphic Engineer and Superintendent. London: Longman, Green, and Longman.

TELEGRAPHIC MEMORANDA.

THE following series of brief *Notices,* illustrative to some extent of the telegraphic operations of the past year, will, we trust, be acceptable to those of our readers who are interested in the progress and extension of land and submarine telegraphy. We shall endeavour to render the *Telegraphic Journal* a complete *record* of all such events and proceedings relating to Telegraphy. The meetings (as far as they relate to electrical science) of *scientific societies,* and those of Telegraph Companies, will be fully reported in our columns for the information of our scientific and commercial readers.

The Atlantic Telegraph Company announce that they had appointed a scientific committee, consisting of William Fairbarn, F.R.S., Joseph Whitworth, F.R.S., Professor Thomson, F.R.S., and Professor Wheatstone, F.R.S., in conjunction with their engineer and electrician, C. F. Varley, Esq., to advise on the most suitable form of cable for submersion in the great depths of the Atlantic.

A submarine cable successfully laid between Cagliari and Sicily.

In the first instance only a portion of the line was laid—from Cagliari to the Island of Maretimo—in consequence of the cable being too short for the whole distance, upon which the steamer "Hawthorn" was ordered to Malta to ship additional cable to complete the line, which was successfully accomplished.

The central station of the London and Westminster Bank connected with its branch establishments in Southwark and in St. James's, the work being executed by Messrs. Reid Brothers, and the instruments (Wheatstone's) supplied by the Universal Telegraph Company.

A large and extensive forest, composed almost entirely of the *ficus elastica* or caoutchouc tree, discovered in Madagascar by English explorers.

A large and influential meeting, held at the Public Sales Rooms in the Liverpool and London Chambers, for the purpose of hearing from the Right Hon. Stuart Wortley an explanation of the then existing position and favourable prospects of the undertaking for establishing an Atlantic Telegraph, Sir William Brown, Bart., presiding. The meeting was also addressed by several gentlemen of influence in the town, and a large amount of subscription promised towards carrying out the project, Mr. Rankin heading the list with a contribution of £500.

The French Government determine to institute a series of experiments with the typo-telegraph, invented by M. Bonelli, with a view of its adoption on some of their principal lines.

The Universal Private Telegraph Company issue a new prospectus, the board having been strengthened by some Manchester names. About 2,000 of the 7,600 shares of £25 each are offered to the public.

The French Emperor's speech, consisting of nearly 1,360 words, or 6,800 letters, transmitted from Paris to London in twenty minutes, four wires being employed.

Experiments made with Hughes's printing telegraph between London and Birmingham, when a large number of gentlemen interested in the science and practice of telegraphy attended by invitation at the central office of the United Kingdom Telegraph Company, Gresham-house, to witness the working of the instrument. The following noblemen and gentlemen attended:—The Right Hon. the Lord Mayor, M.P., Lord Ranelagh, Lord Alfred Churchill, M.P., James Wyld, M.P., Sir Frederick Smith, M.P., the Hon. A. S. Kinnaird, M.P., Joseph Somes, M.P., Sir Robert William Carden, Sir Daniel Cooper, Lieutenant-Colonel Patrick Stewart, Roger Cunliffe, Esq., Thomas Hankey, Esq., &c. The exhibition of the instrument pleased and surprised all present.

The Colonial Parliament of New South Wales authorise the construction of extensive lines during the year 1863.

The Telegraph to India Company (Limited), formed for "the special object of utilizing the cable laid down by the Red Sea Company from Suez by Aden to India," publish their report, in which it is stated that the station at Tubal was discontinued, and that a lease had been granted to Messrs. Glass, Elliott, & Co., of the Alexandria and Suez line, for four years, at a rental of £2,500 per annum, and that the Company had "applied for and obtained the sanction of his Highness the Viceroy of Egypt to construct a line to El Arish, with a view of completing the further communication to Beyrout, Iscanderoon, or Aleppo, and so connecting the company's line with Constantinople by one about to be constructed by the Ottoman Government from Diarbekir on the direct line from Constantinople to India, by which means a portion—and, in case of accident to the direct line, the whole—of the India and China messages would pass through the company's line."

The construction of a line of telegraph from Cape Town to Graham's Town agreed upon.

A severe gale, causing considerable damage to lines of various telegraph companies, especially in the north of England.

A telegraph line, constructed in the interior of the tube of the Pneumatic Despatch Company by Messrs. Reid Brothers, between the branch post-office in Seymour-street and the railway-station, Euston-square.

A very interesting historical and statistical paper, read before the Society of Arts by T. A. Masey, Esq., "On Submarine Telegraphs," which led to a protracted and important discussion, in which the following gentlemen took part:—Thomas Webster, Esq., F.R.S., Rear-Admiral Elliott, Dr. Wallich, Admiral Sir Edward Belcher, Colonel Shaffner, Captain Selwyn, R.N., John Macintosh, Esq., Cromwell F. Varley, Esq., &c.

The second ordinary meeting of the Telegraph to India Company held at the London Tavern.

A committee of naval officers appointed in Washington, United States, to inquire into the practicability of connecting all the naval and military stations between Fortress Monroe and New Orleans by submarine telegraph cables, and an application was made by Messrs. Glass, Elliott, & Co., to manufacture and submerge cables connecting all the points between Washington and New Orleans.

The Electric and International Telegraph Company issue their half-yearly report. The revenue of the half-year amounted to £117,074, which exceeded by £6,009 that of the corresponding period of 1861, and a dividend of £3 10s. per cent. declared for the half-year. The directors state that the cables and the general condition of the whole property was in every respect satisfactory. The engineer reports the mileage as follows:—

Miles of line	7,597
Miles of wire	35,066
Number of instruments	4,003

The first report of the Universal Private Telegraph Company published, showing the extent of the company's lines in various towns, and accompanied with a balance-sheet, showing a profit of £1,017 6s. 3d.

The London District Telegraph Company issue their half-yearly report, showing that the company continued steadily to progress:—

Year.	Net Receipts. £ s. d.	Number of Messages.	Stations open.
1860	1,609 19 1	73,480	52
1861	4,729 17 5	142,724	77
1862	7,955 7 10	251,548	84

A paper read before the Society of Arts by Thomas Webster, Esq., V.P., F.R.S., on Submarine Telegraphy, which gave rise to a considerable amount of discussion, in which the following gentlemen took part:—Fleeming Jenkin, Esq., C.E., Thomas Allan, Esq., Walter Hancock, Esq., Dr. Collyer, C. F. Varley, Esq., — Huxley, Esq., the Right Hon. J. Stuart Wortley, C. W. Siemens, Esq., F.R.S., T. A. Masey, Esq., Rear-Admiral Sir Edward Belcher, Owen Rowland, &c.

A meeting of merchants, manufacturers, and others interested in an Atlantic Telegraph, was held in the Council Hall, Sheffield, to hear an address from the Right Hon. James Stuart Wortley, chairman of the Atlantic Telegraph Company, when the position and the object of the company were fully explained.

A new Telegraph Bill brought before Parliament, its object being to make general regulations in respect to all telegraph companies existing and future, but not to affect existing companies in respect of a past exercise of power.

Several large meetings held in provincial towns by the friends and supporters of the United Kingdom Telegraph Company, which resulted in a considerable accession of capital.

A deputation from Bonelli's Telegraph Company, consisting of the chairman and several directors, waited upon the Right Hon. T. M. Gibson, M.P., at the office of the Board of Trade, on the subject of the new Telegraph Bill.

A paper read at the Inventors' Institute by Captain J. Selwyn, R.N., on the rise and progress of submarine telegraphy, and especially as regards the various inventions used for the submergence of deep sea cables. A discussion ensued, in which several gentlemen connected with telegraphy took part.

The half-yearly meeting of the Submarine Telegraph Company held, when it was stated that during the past year 172,831 messages had been transmitted against 137,714 for the previous six months, and showing an increase of 35,167 messages; and that the receipts were £23,427 5s. 6d. against £18,517 18s. 8d., or an increase of £4,909 9s. 9d.

A deputation connected with the Anglo-Australian and China Telegraph, in reference especially to the portion of the line between India and Australia *vià* Java, had an interview with the Chancellor of the Exchequer.

A deputation on behalf of the British Electric Telegraph Company had an interview with the Right Hon. T. Milner Gibson and the Right Hon. W. Hutt at the office of the Board of Trade.

The directors of the Atlantic Telegraph Company announce that more than two-thirds of the first issue of preferential shares had been subscribed for.

The failure of one of the most important links in the Channel Island Telegraph Company's lines announced.

A large meeting held in New York, at which Mr. Cyrus W. Field

spoke upon the subject of the Atlantic Telegraph Company. Several resolutions were passed declaring confidence in the success of the undertaking, and subscriptions to the amount of £38,000 reported.

The Magnetic Telegraph Company announce that, through the successful submersion of a telegraph cable in the West of Ireland, they had placed Greencastle in connection with the whole European telegraphic system. The result being that the Canadian steamers would for the future be signalled at once on their arrival, and two or three hours gained in the transmission of news and despatches to the metropolis and other commercial towns.

Some interesting discussion took place in the House of Commons on the electric light and lighthouses.

The council of the Society of Arts, in accordance with the suggestion of Sir E. Belcher, appoints a committee to inquire into the subject of submarine telegraphy. The committee to consist of the following gentlemen:—F. A. Abel, F.R.S., C. Brooke, F.R.S., Captain Donnelly, R.E., Captain Galton, F.R.S., W. R. Grove, F.R.S., E. Hamilton, Esq., Professor W. A. Miller, F.R.S., Sir Thomas Phillips, F.G.S., Major-General Sabine, F.R.S., Thomas Sapwith, F.R.S., W. Spottiswoode, F.R.S., Thomas Webster, F.R.S.

A Report published by the superintendent of South Australian telegraphs on the proposed Anglo-Australian and China telegraph scheme.

The Atlantic Telegraph Company applies to Her Majesty's Government for a grant of a sum of money in addition to that which had been subscribed by the public.

Several additional lines of telegraphs constructed for uniting the various stations of the London Fire Brigade establishments: the wires being erected by the London District Telegraph Company, and the instruments supplied by Messrs. Siemens, Halske, & Co., of Westminster.

(*To be continued.*)

TELEGRAPH PROPERTY.

AMONG the numerous startling discoveries that have marked the first half of the nineteenth century, there is not one more wonderful in itself, or more astonishing in its operations and results, than the Electric Telegraph. It may now be considered as one of the necessities of the period, and so far as we can at present anticipate, there is no saying to what extent it will be employed. In fact, Electricity itself, is still but in its infancy, and has hitherto been but little developed, except for the purposes of telegraphing.

More wonderful than steam and, although yet but partially understood, still under almost perfect control; infinitely superior to anything at present discovered for all purposes of communicating whether far or near. We doubt not but that Electricity will command an important position, whether considered scientifically or in a more practical and commercial point of view.

So far as the utility of the Electric Telegraph is concerned, we are bound to acknowledge that, up to the present time, it has been more generally developed in America than in this country. This, however, is attributable to various local circumstances. In that country the postal services are not to be compared with our own; their principal cities and places of business are far more distant from one another than in this country; the Americans are naturally great patrons of anything of go-a-head nature, and these various causes have led to a comparatively low tariff and present use of the telegraph. In that country the dividends of the various Telegraph Companies vary from 10 to 7 per cent., and the shares are consequently reported as a safe and profitable investment. The Continental Telegraphs, on the other hand, are almost entirely in the hands of the various Governments, and no opinions can therefore be offered as to their commercial value. There is, we are glad to see, an evident disposition to reduce the tariff as much as possible in several countries, which will no doubt lead to a satisfactory result, both to the foreign telegraphs and our own.

Our present purpose is, however, to submit to our readers the great progress that has been made by the principal Telegraph Companies—those in operation in this country—as shown by a Parliamentary Return of Miscellaneous Statistics recently issued:

ELECTRIC TELEGRAPHS.

Statistics of Electric Telegraphs for the Use of the Public, in the United Kingdom, in each of the Years 1859, 1860, and 1861.

TELEGRAPH COMPANIES.	Length in Miles of Telegraph Lines.			Length in Miles of Wires used.			Number of Stations open for the Public.			Number of Instruments.			Number of Public Messages.		
	1859.	1860.	1861.	1859.	1860.	1861.	1859.	1860.	1861.	1859.	1860.	1861.	1859.	1860.	1861.
Electric and International*	6,272	6,541	6,727	31,346	32,148	32,787	428	476	772	3,194	3,352	3,529	1,025,269	1,117,361	1,201,515
British and Irish Magnetic†	3,719	3,768¾	3,903	16,595	16,661	17,043	382	386	401	923	1,073	1,084	549,880	608,332	689,738
South-Eastern Railway‡	308½	308½	309½	1,548½	2,087¼	2,432	87	88	89	129	133	135	43,156	48,897	55,085
Lond., Brighton, & So. Coast Ry.	123½	162½	192	247	325	396½	29	30	35	92	114	131	11,425	14,664	21,680
London District §	—	73½	92¼	—	335½	378¼	—	52	78	—	72	188	—	74,582	144,022
Total	10,423	10,854¼	11,228¾	49,736½	51,556¾	53,036¾	926	1,032	1,375	4,338	4,744	5,067	1,629,730	1,863,839	2,112,040
Submarine. (Telegph. to Calais, 24 m.; to Boulogne, 25 m.; to Dieppe, 78 m.; to Jersey, 30 m.; to Ostend, 70 m.; to Hanover, 280 m.; and to Denmark, 380 m.	—	—	887	—	—	2,484 Submarine.	—	—	474 in United Kingdom, and about 3,000 in Foreign Countries.	—	—	54 exclusively for Continental Traffic.	—	—	About 230,000 to & from Foreign Countries

* On 31st December, 1861, this Company had 123 agreements with Railway Companies and with Public Offices for the transmission of their Business Messages. The number of such Messages is not precisely recorded, but is estimated as amounting to three times the number of Messages sent by the general public. This Company had, on the same date, contracts for supplying intelligence to 175 Journals, and to 99 Institutions, but no record is kept of the exact extent of the matter transmitted. It is, however, estimated that this intelligence, in addition to the continental work passing over the Company's Submarine Cables, amounted, at the date referred to, to a total of 756,485 Messages.

† The number of Messages to and from the Continent transmitted jointly by this Company and the Submarine Telegraph Company, and the number of Messages for Railway Companies, Newspapers, and News Rooms, are not included with the messages for the public, but are estimated at about 250,000 Messages per annum.

‡ The South-Eastern Railway Company has no working arrangements with either of the Electric Telegraph Companies.

§ Exclusive of private telegraphs provided by this Company for firms and persons having two places of business.

The foregoing must be considered very satisfactory, more particularly, when it is considered that the large increase in the number of messages transmitted by the various Companies, has not led to a corresponding increase in their working expenses.

(*To be continued.*)

JOHN WATKINS BRETT.

In every age and in the progress of every science there are men who for ever stand out as landmarks in the history of the wonderful inventions which now constitute a large portion of the working material of our every day life. Such was Watt with the Steam Engine, Wedgewood with Pottery, and such was John Watkins Brett with the Submarine Telegraph.

Although several may claim the honour of the invention, yet none, I believe, will ever dispute the title of "Founder" of the Submarine Telegraph to John Watkins Brett.

How Mr. Brett first became associated with the science is best told in his own words. In his work on the *Origin and Progress of the Oceanic Electric Telegraph*, he says:—"My first idea of Submarine Telegraphs arose out of a conversation with my brother Jacob, early in 1845, when discussing the system of Electric Telegraphs as then recently established between London and Slough; and in considering the practicability of an entire underground communication, the question arose between us, 'If possible under ground, why not under water? and if under water, why not along the bed of the ocean?' The possibility of a Submarine Telegraph line then seized upon my mind, with a positive conviction, which led to the consideration of a plan for an entire new principle of Subterranean and Oceanic Electric Telegraphs.

"My brother being possessed of great natural mechanical talents, also at once occupied himself with the embryo model for a printing telegraph, to work by a single wire. Having completed our plans, my brother and I registered a company (June, 1845), for uniting America with Europe, by the very route since carried out, but at that time failed to obtain the attention of the public, it being considered too hazardous for their support. Having failed in July, 1845, in our offers to the English Government to unite Dublin Castle with Downing-street, I applied in 1846 to the French Government for a privilege to lay a Submarine Cable between Dover and Calais, which was accorded by Louis Philippe, and subsequently renewed by the Emperor of the French, and the present cable between Dover and Calais was laid on the 25th September, 1851, but an experimental line had been submerged the previous year, by which I passed the first electric message ever sent from one continent to another, which was printed by the instrument in Roman type. In 1847 I applied for a concession to the King of the Belgians, and, finally, in 1852, obtained this privilege, under which the second cable to the Continent was successfully laid on the 6th May, 1853, from Dover to Ostend.

"On the 19th July, 1852, the Act for the European and American Telegraph Company was obtained at my cost, and I laid down, by virtue of this Act, the underground lines from Dover to London, Birmingham, Manchester, and Liverpool.

"The great objects I continually had in view were the submarine lines eastward to India and westward to America.

"In June, 1853, I obtained the concessions from the French and Sardinian Governments for the Mediterranean, as part of the Indian line. In January, 1855, I entered into an agreement with the New York, Newfoundland, and London Telegraph to establish the Atlantic Line, and Mr. Cyrus W. Field having united with me to carry out this enterprise, the present Atlantic Company was formed in 1856 for that purpose."

It is unnecessary further to recapitulate in detail, as the circumstances are so well known, the part which Mr. Brett took in establishing the present system of telegraphic intercourse across the channel between England, the Continent, the Mediterranean and the Atlantic.

Much has been unjustly said against the exclusive privileges granted by different foreign governments to Mr. Brett, in ignorance of the great benefits which these same privileges have conferred upon the public. For instance, when the through communication was first opened between London and Paris, the charge for a single message was 17s. 6d., and Mr. Brett incessantly laboured until the price was reduced to the present charge of 5s., and he was one of the first to advocate the universal 1s. rate.

The science of Telegraphy has lost—if I may be permitted to use the expression—the father whose fostering care controlled and developed nature's mysterious and intangible agent, and taught the infant Submarine Telegraph first to lisp a few words across the channel in 1850, and lastly to speak across the Atlantic, and whose electric voice is now heard issuing from the depths of the ocean to the furthermost parts of the world, uniting shore to shore, annihilating time and space, and cementing amity and peace between the different nations of the earth. Surely this was a great and noble work.

With a mind so essentially practical, it is rare to find associated the finer qualities of a refined taste for art; yet in the instance of Mr. Brett, the intuitive gift of a painter early developed itself, and was matured by study; although his works as an artist are little known beyond his family, who possess many proofs of his talent as a painter, in the sketches made in a tour through America, and the highly finished drawings in their possession. His gallery of the works of the Old Masters, has been a source of admiration to all who have had the pleasure of viewing it. Nor was his taste only confined to pictures, as his collection of antiquities, bronzes, coins, objects of vertu and books attests. The death of this talented man has left a great blank in the circle in which he moved, for he was essentially one of nature's own gifted gentlemen. Gentle and kind in disposition, resolute in purpose, and endowed with great natural talent and vigour of mind.

By his first grand success in Submarine Telegraphy, Mr. Brett had linked together the Old World. It remained to achieve the triumph of connecting that Old World with the New, but he has not survived to witness the ultimate success of those efforts in which he took so large a share.

Like many other inventors, he had the mortification of experiencing some failures, but his conviction of the final success of the Atlantic Telegraph remained firm to the last; and although as a mere mercantile speculation, it has proved comparatively a failure, yet within a few weeks of his last illness, he was working hard to resuscitate the Company, and had the gratification of seeing the labours of himself and others crowned with success so far as a a sufficient subscription for a new cable.

Familiarity with the wonderful in the present age, renders us too careless in observing and appreciating the marvellous characteristics of scientific achievement, and too often, there is scarcely time for pause to give the laurels to the deserving individual, before another claims the wreath for yet greater intellectual and scientific triumphs. But in the world's race after distinction and honours, few men, heedless of fame, although inwardly conscious of greatness, have the nobleness to refuse a King's favour, because offered to them on a Sunday; or resign an Emperor's decoration in favour of a younger brother, lest he feel disappointed at not receiving an equal reward for labour that was shared.

The writer of this brief memoir, had the privilege of an intimate acquaintance with Mr. Brett for upwards of twelve years, and therefore had an opportunity of witnessing, and becoming acquainted with his many noble and estimable qualities; amongst them were conspicuous, piety and charity; of the first, it is hoped he has received the reward; of the second, he has left testimony in giving by his will, tithes of all he possessed.

Mr. Brett was never married, and died on the 3rd December, 1863, at the age of 58, and is interred in the family vault, in the churchyard of Westbury-upon-Trym, near Bristol, his birth-place.

T. A. M.

GISBORNE'S STEERING AND ENGINE SIGNAL APPARATUS.

Of all the numerous and important purposes to which electricity has been applied, there are but few which possess a higher claim to our favourable notice for its utility and the advantages it confers than the above simple, ingenious, and highly efficient apparatus. Its practical value is attested by its employment on board several of Her Majesty's ships, such as the steamship "Radamanthus," the iron-clad steamship, the "Royal Oak," etc., and also on board the Imperial Russian iron-clad steam-battery, the "Pervenetz," and in each the arrangement has given perfect satisfaction. By the means of the instrument the officer in charge of a vessel may, from any desirable position upon her deck, transmit his orders to the helmsman or engineer; and every such order will instantly appear in *printed letters* before the last-named officials, and remain in sight as long as may be required. Whatever may be the condition of the elements, the order is transmitted with absolute certainty, without possibility of mistake, and is accompanied by the ringing of a bell to command prompt attention. By a single motion of the engineer, or of the helmsman, the officer of the deck instantly receives the reply to his order, and at the same moment the *movement of the helm* is made known, with perfect accuracy, to that officer (inde-

pendently of the helmsman), before it is possible for the vessel to answer to it. This result is made certain, even though the weather should be so thick that the officer could not see an object only six feet from him. The patentee invites those interested in the application of electricity to so useful a purpose, to call and examine the apparatus, which is to be found at the establishment of Messrs. S. W. Silver & Co., Bishopsgate-street Within, and where its construction and its mode of action are fully explained.

GOVERNMENT APPOINTMENTS ON THE ELECTRIC TELEGRAPH STAFF OF INDIA.

In May next, twenty-five appointments will be made in the Telegraph department of the India Office, and as these will be given to candidates who pass most successfully a competitive examination to be held in May, it is necessary that all those who intend to compete, should at once take steps to qualify themselves. We are given to understand, that the candidates must be native British subjects, not less than eighteen, nor more than twenty-four years of age, and must either have passed two years in the service of a Telegraph Company, or as an articled pupil of a Telegraph Engineer, or must have given special attention to Chemistry and Physics at some School or College, recognized by the Secretary of State. These seem but easy terms upon which to enter for these valuable appointments, which range from £15 to £30 per month; but it is also compulsory that the successful candidate obtain in his examination at least 2,000 marks out of 5,000, in the various subjects to be selected by the Examiners. This will doubtless ensure a careful selection of competent young men to fill vacancies in a department that is viewed in the most important light by the Indian Board, and we shall look forward with much interest to the result of the examinations, so as to find if the subject of Electricity and Telegraphy is made part of a scholastic education. It has not hitherto been the custom of our chief Telegraphic Engineers to take articled pupils. The profession has been regarded hitherto as a branch of engineering scarcely so distinct as it should be, for it is one that to succeed, must not be mixed up with other branches. It requires an amount of care and study sufficient to occupy the sole attention of those who follow it; and the decision of the India Board will perhaps influence parents and guardians to adopt timely measures, so that in addition to the ordinary Mathematical Education so desirable for the proper appreciation of electro-statics, or electro dynamics, they may afford young men the opportunity of acquiring a practical knowledge of Electro-Telegraphy, by placing them "for two years in the service of one of the English Telegraph Companies, or as articled pupils of a Telegraphic Engineer."

We strongly recommend, that in public schools, the prizes should be varied by presenting to pupils some piece of philosophical apparatus, such as the Microscope, Electrical Cylinder Machine, Induction Coil, or Galvanic Battery. They can be obtained readily in such a form, as would prove not only interesting, but highly instructive to the student, who would then begin to form his mind upon the particular profession he would afterwards select. Should the Electric Telegraph prove a source of attraction to him, there would be no difficulty in finding one of the many Telegraphic Engineers who would accept him as a pupil, and with whom he would have ample opportunity of obtaining that practical information, without which, the aspirants to future appointments such as those to be awarded in May next, will seek in vain.

DISCHARGING OR REVERSING APPARATUS FOR SUBMARINE CABLES.

The Government telegraph to India have had made, by Messrs. Silver & Co., some of Mr. Andrews' (Secretary and Manager of the United Kingdom Telegraph Company,) pneumatic arrangements for line reversal currents, in line discharges of submarine circuits. The apparatus have been for some years exclusively employed, with the most satisfactory results, by the Submarine Telegraph Company, for working their long cables. According to the system employed by Siemens, the apparatus used for throwing in reverse currents, for relay stations, is fixed to the Morse train, and does not, therefore, admit of adjustments so as to throw in currents of greater or lesser duration; and an accident to the train stops the communication. Working from the key, direct from one station to another station, the key is held constantly on one side, so as continuously to send the reverse current. The same result is obtained in Bailey's system, and the practical consequence is, that the distant station must wait for the completion of the message before it can speak with the sending station, although the matter received may all be incorrect. In Mr. Andrews' arrangement those difficulties are obviated, and this advantage is very great, especially on rapid working ærial lines, where, to facilitate the regulation, the reverse current system is employed. Its importance, on submarine circuits, is also considerable.

The arrangement is as follows:—An ordinary pair of electro-magnets, vertically placed, and a horizontal bar, are provided; the bar is rather longer than those ordinarily used; the one end of this bar works between two insulated contact points, the upper one connected to the relay, the lower to the reversal battery, or the earth, according to the system employed, whether reversal or discharging. A spring on the under side of the bar is used, to lengthen the contact with the lower contact point. Attached to the under side of the bar, near the contact point, is a piston of German silver, with a valve formed by a round ball of alluminium, working in a socket open at the bottom; this piston and valve work up and down in a cylinder of ebonite, or other material, partly filled with chronometer oil. When the relay is attached, it sends the current from the local battery through the Morse writer, and the electro-magnet is the pneumatic arrangement. The armature of the latter brings down the bar and piston; the valve opens, and the oil passes through. On the current arising, the spiral spring draws up the bar, but as the oil can only pass slowly down again, between the sides of the valve and the cylinder, to fill up the vacuum created, the bar rises slowly, according to the strength of the spring and the stroke of the piston. The apparatus admits of such accurate adjustment, that the distant end, if desirous to speak, may do so at the end of each word, or between letters or sentences. For direct working, two small springs, horizontally arranged, and overlapping, but not touching one another, are placed under the ordinary Morse handle, and when the latter is depressed the two springs are brought into contact, and the local battery sends a current through the coil of the pneumatic apparatus as before mentioned; no resistance, therefore, is thrown into the line. The friction is almost nil, and a single cell will work the apparatus; the stroke required is also extremely short. The working does not vary, and the apparatus works with remarkable precision and certainty.

ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.

Mr. J. S. Fourdrinier has retired from the appointment of Secretary to the above Company, after fifteen years of arduous service, during which time he has raised that Company's system from one comparatively small and insignificant to a most exalted position, both in a financial and business-like point of view. No one who knows what is involved in the organisation of a large telegraph system will deny that the labour is incessant, and compels the *Chef du Cabinet* to watch closely all the details of the concern. It is in our power to claim for Mr. Fourdrinier the utmost credit for his conduct in this respect. A more unwearying, conciliating, or faithful officer is not to be found in the ranks of the eminent men composing the staff of the Electric Company, and if the award of labour is success, then we shall surely not be denied, if we claim for the gentleman, whose services the Company now loses, the highest award, inasmuch as the status of the Company will bear comparison with any mercantile undertaking of the day.

In all its details—in every department—the duties of each and every one are carefully defined. An error in a message, delay to an express, interruption on the line, or derangement of the apparatus—no matter what the fault—there is no difficulty in deciding upon the party to blame, and thus while each knows his responsibility, he is careful not to be found wanting in his duty. Of this highly systematic state of things the late Secretary was almost, if not entirely, the founder, and we can readily speak of it as a personal point that he had a rule for everything It, in fact, was proverbial that he had so framed the rules and regulations of the Company's service that it was impossible to go out of the strict course of business without breaking them.

It is certain that few men could have grappled with a new "idea"—a system, which, as the late Mr. Ricardo once said, "had required even a new language," and have brought it so systema-

tically into a daily routine as to convey with such remarkable precision and regularity the interminable amount of business that now passes over the Company's system from the northern extremity of Great Britain to the Land's End. To any stranger, the wires of the Electric Telegraph Company, if drawn upon a map without showing their connections, would be an inextricable web. To arrange the working of such a system would be a Herculean task. The question of staff would lead one to think of the formation of a battalion. And this was, in fact, the chief secret of Mr. Fourdrinier's success. He recognised the duty of each officer in his grade; his was the responsibility. One hand guided the good ship, and he steered it well, and we are glad to know that he leaves the vessel in a sound condition, and with such a mark of approval from the directors as does credit alike to Mr. Fourdrinier and to the Electric Telegraph Company.

Mr. Fourdrinier is succeeded by Mr. H. Weaver, one of the oldest officers in the service, he having joined the Company in May, 1846, previous to its incorporation.

Mr. Weaver was resident on the Continent for several years as manager of the International Telegraph Company, and returned to England in 1859, replacing Mr. D. P. Gamble as Metropolitan Superintendent, in addition to the management of the Company's Continental business.

REVIEWS.

MAP OF EUROPE. Compiled from the most recent surveys, published for the Electric and International Telegraph Company, showing the system of Telegraphs with which they are connected. By H. WEAVER, Esq., Met. Supt. of the Electric and International Telegraph Company. London, 1863.

This is a valuable contribution, not only to the telegraph service, but as affording to the public at large a ready and intelligible means of ascertaining at a glance the vast and wonderful ramifications of the system of European telegraphy. The extensive employment of telegraphy for political, commercial, and private purposes has long rendered such a map highly necessary, and we hail with satisfaction its appearance, especially as it has been designed and constructed by a gentleman whose extensive information and experience in telegraphic matters are a guarantee as to its correctness and fidelity. The lines and stations are clearly and distinctly marked, and the various countries traversed are designed by a judicious system of colouring. Less than twenty-one years ago, in a language almost bordering on despair, the faithful and persevering inventors, Messrs. Cooke and Wheatstone, state, —"At the beginning of the year 1843 we were at our lowest point of depression. The patents remained almost unproductive, and we had incurred in various ways a considerable outlay." Let us trace on the map the short line at the time constructed between Paddington and Slough: to the west it has reached the western coast of Ireland, and terminates at Castlebar; to the east, leaving London, it passes through numerous counties and towns to the shores of the German Ocean, and continues its course beneath its waves to Heligoland, where, after another short submergence, a branch line extends to Copenhagen, Stockholm, and Christiana, the capital cities of Denmark, and Norway respectively. The main line proceeds, accommodating on its way the cities of Hamburg, Berlin, and Warsaw, &c., to St. Petersburg, on the banks of the Neva; thence to Moscow, and terminates at the city of Omsk in Siberia, on the frontiers of China!—a distance of some four thousand miles. A line extends from Moscow to Odessa, and from hence to Tscherkash on the banks of the Don. Another line, starting from Valencia, the proposed station of the intended Atlantic Telegraph Company, on the western coast of Ireland, after passing through Cork and several other towns, crosses the St. George's Channel, and runs along the western counties of England to the metropolis, from whence it proceeds south across the English Channel to Paris, Munich, Vienna, Pesth, Schumla, &c., to Constantinople, where it is ultimately to meet the great Indian line now in course of construction, when direct communication may be effected between the Irish shores of the Atlantic and Calcutta, in the remotest part of British India.

SILVER'S GUIDE TO AUSTRALASIA, and Itinerary to and in the Colonies of Victoria, New South Wales, Queensland, South Australia, Western Australia, Tasmania, and New Zealand. S. W. SILVER & Co., Bishopsgate-street, E.C.

A very useful compilation of some 150 pages. It contains a large amount of information upon all matters relating to the colonies, and several exceedingly well-constructed and coloured maps. We quote the following items on the subject of colonial telegraphy. Victoria has now "a network of telegraphs, extending over 1,500 miles, communicating with sixty stations; it spreads over the colony, and corresponds with the telegraphic system of South Australia, New South Wales, and Queensland." Of New South Wales it is stated almost all the chief towns are connected with Sydney by electric telegraph; and the New South Wales system is in communication with the Victoria, South Australia, and Queensland lines. The chief lines are:—1. The line from Maitland to Singleton, Murrundi, Tamworth, Armidale, and the southern frontier of Queensland, 400 miles. 2. From Bathurst to Sofala, Tambaroora, Louisa Creek, and Mudgee, 97 miles. 3. From Gundagai to Tarontta, Wagga Wagga, and Deniliquin, 700 miles. This line corresponds with the line from Deniliquin to Echuca, Castlemaine, Ballaarat, and other places in Victoria. 4. From Gundagai to Kiandra, Snowy River Diggings, 87 miles." In South Australia, "Three telegraph lines are open; the first two follow the lines of railway, and the third from Adelaide to Kooringa and Kapunda, and further on to the frontier corresponds with the Intercolonial Junction line which connects South Australia, New South Wales, and Victoria." In Tasmania "a line of electric telegraphs, 124 miles long, connect Hobart Town and Launceston."

The Directors of the London District Telegraph Company (Limited) have published a very useful little Almanack for the year 1864. It contains a list of all the Company's stations in London and the suburbs, with the scale of charges for the transmission of messages. The Almanack is published in such a form that it can be kept in the folds of an ordinary pocket book.

COLONIAL TELEGRAPHY.

UNDER the above heading it will be our effort to place on record the progress made in telegraphy in all our colonial possessions. The subject of Colonial Telegraphy is one of considerable importance, especially as its development must lead to the extension of our submarine system. We shall always be thankful to any of our subscribers who will kindly favour us with information upon the above important subject.

CAPE OF GOOD HOPE.—At least six months within the Government contract time we shall have the telegraph from Cape Town to Graham's Town completed. In selecting Messrs. Siemens & Halske for the execution of the work, the Cape of Good Hope Telegraph Company—most efficiently represented here by Mr. Wollaston—appear to have acted wisely, for, from all we understand, the work is done most substantially, and will, when finished, probably be one of the best-constructed lines of telegraph which has yet been erected, The Company has before it every chance of success. The meeting of Parliament next year in Graham's Town will put the practical working of the line to a test, and give proof of the incalculable benefit of a telegraph line running upwards of six hundred miles from one extremity of the colony to the other. By the time our friends in England have the opportunity of replying to letters leaving by the mail to-morrow, they may save some days in communicating with Port Elizabeth and Graham's Town by making use of the telegraph. We are informed that arrangements are in progress under which persons in England will be enabled to communicate with their correspondents at either of those towns, by sending their messages to the offices of the Company in London, paying one shilling extra for the postage to the Cape; the messages so sent being forwarded from Cape Town by telegraph, immediately upon the arrival of the steamer in Table Bay. This will be an immense advantage to the merchants of Port Elizabeth and Graham's Town. The line is already finished from Port Elizabeth to eight miles this side of Swellendam; and a working party is about to commence operations at Cape Town with a view of accelerating the completion of the remaining portion of the line. The Telegraph Company are going to construct a line of telegraph along the Wynberg Railway, and will place the Simon's Town wire on the poles, removing the Simon's Bay telegraph line from the road between Cape Town and Wymberg. From Salt River the same poles that carry the frontier wire will support the Simon's Bay line. The contractors' assistant, Mr. Holsboer, is about to leave for Port Elizabeth, to repair the Graham's Town and Port Elizabeth telegraph.* Upon the completion of these repairs, the King William's Town and East London line will be placed again in working order, after which the contractor will proceed to Natal to construct the line between Durban and Maritzburg, a contract having been entered into between the Natal Government and Mr. Wollaston, on behalf of the Company, securing a subsidy, payable for a number of years, upon the same principle as the contract for the Graham's Town and Cape Town line. There is every probability of the Natal and Cape Governments, aided by Her Majesty's High Commissioner, agreeing upon terms with the same parties for the extension of the telegraph from its present terminus (Graham's Town) to King William's Town, there uniting with the East London line, and from thence, through Kaffirland, to Natal. We shall then be able to communicate by telegraph with the seat of Government and the principal seaports of all the British colonies in South Africa, an advantage which cannot fail to be of immense value both to the Home and Colonial Governments, and to the commercial community generally. The manner in which the Telegraph Company are doing their work is universally applauded.

* Erected before Messrs. Siemens, Halske, & Co. took the contract for the construction of the new lines and repair of these old ones.

CORRESPONDENCE.

PRACTICAL TELEGRAPHY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—While reading a valuable work, recently published by Mr. R. S. Culley, which contains a great amount of useful information to those engaged and interested in telegraphy, it struck me that were you to devote a portion of your Journal to the diffusion of information founded on experience, you would be conferring a boon upon the telegraph service generally. A medium for the free interchange of ideas among those engaged in telegraphy has long been a necessity. Improvements tending to facilitate and lighten our labours can by such means be made known to the advantage of all; and the great number of youths now engaged in telegraphy will derive much useful information from the contributions of those more advanced in the knowledge of electrical laws and the management of instruments, &c.

J. EASTNOR.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It is with the greatest pleasure I hail the boon that is about to be offered to the telegraphic world, in the form of a periodical devoted to its interest. Perhaps I may be pardoned for offering a few remarks on a point which is of the utmost importance to us telegraph clerks. It is now getting a bye-word among several classes that on the whole English clerks are a "set of lazy fellows," &c. &c., while the continental ones are well up and versed in the science of telegraphy. Why is this? Let us take an example. Two men are set to accomplish a certain work; one has an abundance of books, has a paper that gives him continual instruction how to proceed, and has plenty of instructions to do it. Now let us see the other: he has neither the books, paper, encouragement, nor any one who will take the slightest trouble to give him the least instruction. We would of course naturally say, that the former should do it the best and first. So I maintain it is with the clerks of this country, when compared with those of the continent—one has everything, the other nothing. Therefore, I do not see why the English telegraph clerks should have their characters stained by the words of those who are in ignorance of the cause that brings the effect attributed to them. But now, while there is a prospect of a journal which has for its object the promotion of telegraphic interest, we may expect better things; at the same time I sincerely hope that the promoters will not forget that there are such persons as clerks in the telegraph service, and that the matter which is interesting to the telegraph engineers and electricians will be quite the contrary to a clerk. They require to be brought to it gradually. I should propose that a column or two should be devoted to the explanation of instruments, relays, batteries, &c., and written in such a manner as to interest the readers. I know that your paper is looked forward to with considerable interest, and if you possibly could make a portion of your paper interesting to the above class, you would not only have the good will of almost all the clerks, but you would have your circulation doubled.

But the space of your paper is valuable, and I should not like to exclude far more interesting matter. I will but just ask of you to place these matters under your consideration.—I am, Sir, your obedient servant,

Liverpool. J. R. O.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I shall be rejoiced at the appearance of the "Telegraphic Journal," if it only fulfil the expectations its title is likely to raise.

By all means let it be a "Telegraphic Journal," and not a miscellany of the sciences, "social" included. It is a want greatly felt, and there is none more competent to supply it than yourself.

Be assured there will be no lack of support. A paper devoted to telegraphic interests is evidently much needed, and, therefore, if it turn out a true representative of that interest, it will be appreciated in the most satisfactory manner.

The figures that are frequently published, purporting to give the amount of capital invested in this vast enterprize, and the number of persons employed, afford but an inadequate idea of either the one or the other. If, however, the new journal is conducted anything like, and is really made the exponent of the large, influential, and highly cultivated class engaged in telegraphic operations, you will soon have something approaching to occular demonstration of the multitude so engaged by the number of copies you will have to prepare weekly.

The "Telegraphic Journal" should be as welcome to the humblest clerk—aye, even porter—as to the gentlemen directors themselves, and, moreover, should be as indispensable to the ordinary shareholder as to the engineer and manufacturer; but to be of this cosmopolitan description will doubtless require earnest and close thought, incessant study, talent of no ordinary character, and a mind capable of taking a comprehensive survey of this vast science in all its multifarious and important details; add to which a thoroughly intimate acquaintance with every phase of the class or classes for which you write. Of this, however, you are doubtless more fully aware than I can possibly pretend to be, and, therefore, it might safely be passed over. Still, when one is desirous a thing should succeed, one is apt to be pretty free in dwelling upon various points, which, although not likely to be lost sight of in one sense, are nevertheless apt to make one nervous, lest all the time their prominent self-evidentness, being so constantly uppermost, should lead to a depreciated estimate, and this chiefly by virtue of their extreme familiarity.

You will pardon my free way of writing, but I feel satisfied that success depends upon the manner in which the journal is conducted and its general getting up. It is hardly fair to complain of a want of support if the journal does not as a whole contain that which is interesting to those who are expected to purchase it.

There are various grades, as I may call them, to cater for, not one of which you can with impunity ignore the existence of. Nor yet, again, will it be wise to be lavish towards one class at the expense of the other. The large number of amateurs who will seek instruction from your columns will not be so unreasonable as to expect more than a fair share of attention. They will, of course, be prepared to meet with a great deal in your pages which is beyond their comprehension, but this will doubtless only excite them to emulate the knowledge of those so far a-head; but what little space is devoted to them should be couched in language to be easily understood. The deplorable state of electrical nomenclature, and the way eminent individuals are at loggerheads with one another as to the applicability of certain words as denoting certain phenomena is a great drawback to the student in the acquirement of telegraphic knowledge. I, in concert with a great many others, am anxious that this state of things should cease, and trust your journal will be the means of setting many controverted points at rest; but this is only a hint by the way.

Of course the "Telegraphic Journal," as its title would seem to indicate, will be a scientific journal, not in the latitudinarian sense, but only so far as electric and telegraphic sciences are concerned; and in this respect I cannot but hope most earnestly that it will prove itself a text book, and never failing source of the purest description, to which the most advanced electrician will be able to turn to his advantage, conscious of finding at all times something that is worthy to be added to his store of knowledge. But while it should be a scientific journal of pre-eminent standing, in so far as it should be the *ultima thule* of electric and telegraphic knowledge, and its editor, justified by virtue of his superior attainments, in giving *ex cathedra* utterances, still it will doubtless be desirable that its pages should not be too exclusively scientific; indeed it becomes a query whether it should even have any considerable portion of its space taken up every issue with purely scientific matters. There is a large class mixed up and intimately interested in telegraphic affairs in a commercial sense only, and it is no depreciatory way of speaking to say, that a great number of these gentlemen are in blissful ignorance of the reconditics of telegraphic science and the mysteries of electrical theories; and in cases where tolerable acquirements have been made, it is more than probable that it is not made a subject of systematic study. To this class, therefore, a journal overcharged with a difficult subject, and withal uninteresting to them, runs the risk of being thrown on one side unread; and if that occurs a time or two, the question presents itself to them in this form, "Where is the use of my taking a paper which I do not or cannot read?" People of this description take a paper gladly if they can only be sure of finding in it the information in which they are interested. You, sir, know the class to which I refer and the information that will be suitable. News is an important element; do not, above all things, forget the news. Excuse my prolixity. I have been trying to show to you how the "Telegraphic Journal" may be made a success. I hope I have succeeded. Surely everything is propitious. The want exists, and you step forward to supply it. Do it faithfully and to the best of your ability, and sure I am that the eminent and enterprising firm which has undertaken the publishing will never have occasion to regret the step they have taken.—Yours obediently,

Croydon, Dec. 28, 1863. R. W.

[We thank our esteemed correspondent for his suggestions.—ED., T. J.]

TELEGRAPHY AND H.M. GOVERNMENT.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Judging from past and present appearances we have but too much reason to fear that no very important line of submarine telegraphs will be constructed unless Government assistance in some form is vouchsafed to that end. So far as connecting the colonies to the mother country is concerned, the Executive will not fail to see that this is effected, supposing no independent company is organized in the meantime that will forestall them. But we shall be safe in concluding that these things will remain in *statu quo* until it is seen how the cable turns out that is now on its way to the Persian Gulf. If this should prove a success—and we see no reason why it should not—it will give a great stimulus to telegraphic enterprize, but as surely no greater than is required, since every other project languishes from sheer inanition.

The world has gone by extremes, we may suppose, ever since man succeeded to the inheritance down to the present moment. The contrast between the nervous timidity of the present time and the overweening assurance and self-confidence of five years or so ago is as remarkable as it is regretable.

Then schemes were rife which were to encompass the whole earth—east, west, north, and south—with a perfect network of electric communication; the Atlantic was to be regularly zig-zagged with telegraphic cables, and everybody believed not only in their possibility but in their immediate execution. No misgiving had been manifested, and every isle in the Pacific might literally be tacked to our sea-girt shores, and kept there by as mysterious a bond as that which holds the satellites of Jupiter; and we should not only not have said it is impossible, but that it *should be*, and that speedily, although it should have transfixed us with amazement.

Now, however, we creep, and hardly creep, with an excess of caution almost ludicrous. The construction of a few miles of cable is esteemed a far more formidable business than the manufacture of two thousand miles was half a decade since. And when made in the most perfect fashion and passed the rubicon of severe tests which are supposed to represent the grossest aquæan circumstances it will be subjected to, it is finally submerged in something like that unsatisfactory bewilderment which a colossal unknown is supposed to produce, and which cannot be more aptly expressed than as "taking a leap in the dark."

The Government, too, indulges in the same excessive caution, and truly not without a cause. A burnt child ought to dread the fire; but experience should teach the juvenile that caloric is a useful agent in the economy of the world for all that, and, moreover, should reflect in what measure he himself was to blame for the unpleasant results. If the children of this world prove themselves to be wiser in their generation than the children of Downing-street light, the latter are surely capable of profiting by experience, without having recourse to the undignified proceeding of abjuring all similar connexions for the future, and withal should not omit to take stock of their own fair share of the blame.

The indisposition of the Government to assist in the accomplishment of projected lines is a serious drawback to submarine telegraph development. The thing is literally at a stand. The signs of life that are shown are more like the spasmodic action of automata than real life; and yet a little help judiciously held out would be of incalculable advantage, and would result in a measure of success that would amply repay the advances made. All this is more than borne out in the instance of the Atlantic cable. If Government would step forward with ever so little effectual countenance and aid, it is beyond a doubt that a very short time, comparatively speaking, would see this country in direct electric communication with the vast American Continent. As it is, however, a grand enterprize, nobly and heroically begun, sticks half way, and is in danger of coming to nought, or its consummation postponed for an indefinite period, for want of that patronage and aid which might be granted without the donors being any the worse, even in the case of failure; but, seeing that success is certain, it is surely impolitic to withhold that, the bestowment of which would meet with universal approval. This is not the worst, however; the fact of its being blown cold on in such a quarter prevents that spontaneous flow of sympathy and effectual assistance which others would feel disposed to accord. This coldness and indifference is interpreted as an entire mistrust of the whole affair.

Effectual but judicious aid in submarine telegraph extension is just that appropriation of public money, which, as it would be certain to meet with a good return, and moreover forward the noblest of enterprizes, would necessarily be countenanced by that public who provide the Executive so munificently. This is a matter that should be well looked after in Parliament. I much fear that telegraph interests are but inadequately represented there, and, therefore, hope to see the whole subject taken up in your columns from time to time, in order that the duties and obligations of Government may be exactly defined and enforced. Surely, it is high time that the present state of apathetic languor were superseded by rational activity. Of the two extremes this is by far the worse, for it is in a great measure unjustifiable, seeing the great advance that has been made in the science of telegraphy. As far as is possible for the most efficient and elaborate experiments to demonstrate, and, moreover, experience on a small scale, the success of properly constructed telegraph cables is a certainty, about which there cannot possibly be the smallest matter of doubt. It is a thousand pities, therefore, that this noblest of all enterprizes should languish mainly because a nervous timidity is oddly enough in alliance with a petty parsimony.

E. F. G.

TELEGRAPHIC NEWS.

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.—There are two vacancies on the Board of Directors of this Company, by the demise of Thomas Critchley, Esq., and the appointment of Sir John L. M. Lawrence, Bart., G.C.B., to the Governor-Generalship of India.

THE ELECTRIC TELEGRAPH AT THE KENSINGTON MUSEUM.—Several sets of instruments (Wheatstone's) are employed at this important national establishment, as a means of communication between its various departments. The large amount of private and public property exhibited from time to time within the building, rendered it necessary that the most effectual precautions should be adopted for its protection. The system of telegraphic communication is so arranged, that, in case of a robbery being discovered, an instantaneous notice can be given to prevent all egress from the building until a rigid search is made. This ingenious application of electro-telegraphy has relieved the establishment of a considerable amount of anxiety as to the security of the valuable property contained within its walls.

DURING the late severe gales the lines of the Bonelli Telegraph Company between Liverpool and Manchester, suffered serious damage, the two masts at Runcorn Gap being broken and the cable, that crosses the Mersey at this point, carried away. It was, however, secured and submerged, and is now in good condition, but owing to the length of damaged land line still in the hands of the engineer for repair and the large increase of business, rendering it necessary for the Company to open much larger premises in Manchester, the traffic has been temporarily suspended and the offices closed.

TELEGRAPH CLERKS' PROVIDENT FUND.—We learn with satisfaction that the above promising and important institution continues to gain strength by increased patronage and number of members, which now exceeds sixty. The yearly subscriptions amount to £51 18s. 6d., and donations £172 15s., or a total of £224 13s. 6d. Mr. Sheward, the chairman of the fund, who is a member of the Royal College of Surgeons, has kindly agreed to grant certificates free to every member. The Electric and International Telegraph Company's Dramatic Club intend to give a representation, for the benefit of the Provident Fund, early in the month of February.

Mr. L. W. COURTENAY, the able secretary to the Submarine Telegraph Company, has left that company, and entered the service of the Government Telegraph to India, taking charge, we understand, at Constantinople, whither he has already proceeded, to bear part in the preliminary operations necessary to formally complete the requisite arrangements for establishing and carrying on the important system of communication with India, to be inaugurated on the successful submersion of the Persian Gulf cable. Mr. Courtenay has been identified with the system of submarine telegraphy from its infancy. He was secretary to the Société de Mauley et Compagnie, which laid the first metal-coated submarine telegraph cable between England and France, and which, therefore, may be said to have been the parent and forerunner of the magnificent system of continental and insular communication since established. Mr. Courtenay was also the secretary of the Chartered Company that established telegraphic communication between England and Belgium, England and Hanover, England and Denmark, France and the Channel Islands, and subsequently again between England and Boulogne and Dieppe. Perhaps no gentleman possessed a more intimate knowledge of the various Conventions, concluded at different times, between the States of the Continent, for the regulation of telegraphic intercourse, and also of the agreements and working arrangements subsisting between this country and the various Governments of Europe, with most of which, indeed, Mr. Courtenay had had something to do. The Submarine Telegraph Company carried out, during Mr. Courtenay's tenure of office, successive reductions of tariff, which have contributed very greatly to the extension and permanent establishment of the submarine electric telegraph as an absolute necessity to the mercantile and general public. The late secretary was generally esteemed for his courtesy and for his business acquirements; and we think that all our readers who are acquainted with the gentleman of whom we are speaking will join with us in thinking that the Submarine Telegraph Company have lost, and the Government have secured, an experienced and valuable servant. The directors of the Submarine Telegraph Company, on Mr. Courtenay's quitting their service, presented him with a valuable gold watch and chain, bearing an inscription expressing their satisfaction with his long and efficient services, which extended over a period, as we are informed, of some thirteen years.

THE GREAT INDIAN TELEGRAPH.—A telegraphic convention has been recently signed between the Porte and the Persian government, on the basis of the convention of Brussels, which governs the whole of the international telegraphic regulations throughout the different states in which the telegraph system has hitherto been adopted. Mirza Hussein Khan, the Persian Minister at Constantinople, who was to leave for Teheran, will take this convention with him for final ratification by the Shah. It will prove of great advantage to the new line of Indian telegraphs, carried out under the supervision of Lieutenant-Colonel Stewart. In addition to the submarine cables from Bassorah to Bushire, and thence to Kurrachee, the telegraphic land wire will be prolonged from Bagdad to Hanokhan, on the Persian frontier, by the Turkish government, and will be carried on by the Persian authorities to Teheran and Schiraz, and thence to Bushire. The correspondent of the *Times*, at Constantinople, writing on this subject in its stages, in a late number of that journal, states that it is proposed ultimately to extend this land wire through Beloochistan to Kurrachee, and thus to secure uninterrupted communication in case of accidents to the submarine line. After the signature of the convention, a grand dinner was given in honour of the Persian Minister, Mirza Hussein Khan, at which most of the grandees of the Porte were present. The general treaty on the Brussels basis binds only the Persian government with respect to the transmission of messages to Europe. In Asia they have a separate arrangement with the Porte, by which the charge for telegraph messages is fixed at 20 para a league for 20 words. The Persian and English governments are drawing up a special convention on this subject at Teheran.

WEST INDIA ISLANDS.—An offer has been made to connect the whole of the West India Islands by telegraph with the main land at Cayenne, in French Guiana, and Key West, near Florida, if a grant of 6 per cent. on the toll can be obtained. The cost is estimated at £300,000.

SUBMARINE CABLE FOR THE ITALIAN GOVERNMENT.—A submarine cable for the above government is now in course of manufacture at the works of Mr. W. T. Henley, North Woolwich. It is to be submerged between Ottrante and Avalona, and is sixty-two miles in length. We shall in our next number give a full description of the cable.

AMERICAN TELEGRAPHY.—President Lincoln, in his Message to the House of Representatives, recommends to their favourable consideration the subject of an international telegraph across the Atlantic Ocean, and also of a telegraph between the capital and the national forts along the seaboard and the Gulf of Mexico. Such communications, established with any reasonable outlay, would be economical as well as effective aids to the diplomatic, military, and naval service.

La France announces, from St. Petersburg, that a telegraphic line from Eastern Siberia to Pekin has been agreed on by the Russian and Chinese governments, and that a series of block houses is to be conceded to the Czar along the whole extent of the wires, for their protection within Chinese territory, up to the very gates of the celestial city.—*Manchester Guardian.*

MISCELLANEA.

WE are not generally in the habit of considering attentively how intensely cold is space—that the diffusion of heat is only terrestrial, and for a short distance its average diminution, with height, being about one degree for each hundred yards, or sixty degrees for six miles (in round numbers, as an approximation not in excess of observed facts). We look at the sun, feel his apparent warmth, and with difficulty realise the conviction, that by going towards him—our great luminary, visible centre of our system—we should be frozen. What are heat, light, and electricity—three words for, perhaps, only one power or influence, under various forms or conditions—intimately correlated? All-pervading, ubiquitous, incomprehensible now to man, almost infinite in power, rapidity, and extent, though but an agent of the Almighty. Marvellous, indeed, are the effects of this subordinate influence as studied in these forms, and in other combinations, such as magnetism and gravitation. They indicate the power of Divine will looming through the mist of man's materialistic philosophy.—*Admiral Fitz Roy.*

THE PROGRESS of electro-telegraphy during the last twenty years presents a remarkable instance of what can be effected by scientific skill and commercial enterprise in so brief a period. The short experimental wire erected between Paddington and Slough, where, at the former station, the infant Ariel was exhibited on the sight-seeing Easter holidays at "one shilling each person," bids fair to girdle the earth, and Ariel's sway to assume gigantic proportions. The public, through the medium of the daily press, were recently informed that our lightning messenger left San Francisco, on the shores of the Pacific, on a certain day, and after having passed along some 4,000 miles of wire, deposited his despatch on board a swift steamer, which occupied nine and a half days in traversing the Atlantic ere it reached our shores, from whence the despatch was transmitted to St. Petersburg, on the Neva, the whole time occupied being ten and a half days, of which time Ariel occupied scarcely twenty-four hours—thus demonstrating that when an Atlantic cable is successfully laid St. Petersburg and the great telegraphic system of Russia reaching to the frontiers of China will be able to communicate with San Francisco and the British possessions in the Pacific in less than twenty-four hours. There are now no less than 10,000 telegraphic stations in Europe for the receipt and dispatch of messages. In India, 160. In Australia, viz., Queensland, 6; New South Wales, 35; Victoria, 44; South Australia, 21.

THE VELOCITY OF ELECTRICITY AND THE DURATION OF THE SPARK have been made the subject of elaborate experiments by M. R. Felici, who has inserted some notes thereon in the *Annales de Chimiè.* In his opinion, the best method of measuring the velocity of electricity is the observation of the sparks which arise at the interruption of an uncovered conducting-wire freely suspended in the air, and without an envelope of gutta-percha or silk, and traversed by the discharge of the Leyden jar. When we employ a battery and wires covered with gutta percha, and in the very variable condition of telegraph wires, causes of error are introduced, as has been demonstrated, principally by Professor Faraday. M. Felici also expresses his doubts as to the propriety of employing for this purpose the galvanometer or the electro-magnet. In a memoir lately published, he stated that by his apparatus he had determined the velocity of electricity to be, in round numbers, about 260,000 kilometres a second. Since then he has had new and improved apparatus made, which he describes in detail. With regard to the duration of the spark, he observed in his experiments a phenomenon already noticed by Professor Wheatstone and M. Feddersen, viz., that when the spark has a sensible duration it is composed of several sparks of an intensity successively more feeble and separated in themselves by infinitely small intervals of time. There is, consequently, one whole spark and some partial sparks of exceedingly small duration. According to M. Felici, the duration of the spark depends on the relation between the tension and the quantity of the charge. By augmenting the tension and diminishing the charge, the duration of the spark is also diminished. The duration of the spark, he says, also depends on the state of the surface of the metallic balls or points.

HEAT.—M. Stefan has communicated to the Vienna Academy some mathematical researches on the propagation of heat, and considers that the results he has obtained justifies the proposition "that heat propagates itself by radiation with the rapidity of light, by transmission with the rapidity of sound."

THE ROYAL SOCIETY.—At the anniversary meeting of this Society, Major-General Sabine, president, in the chair, the following officers were elected to serve for the ensuing year:—President, Major-General Edward Sabine, R.A., D.C.L., LL.D. Treasurer, William Allen Miller, M.D., LL.D. Secretaries, William Sharpey, M.D., LL.D.; George Gabriel Stokes, Esq., M.A., D.C.L. Foreign Secretary, Professor William Hallows Miller, M.A. Other Members of the Council, *James Alderson, M.D.; *George Busk, Esq., Sec. L.S.; *Col. Sir George Everest, C.B.; *Hugh Falconer, M.A., M.D.; *John Hall Gladstone, Esq., Ph.D.; Joseph Dalton Hooker, M.D.; *Henry Bence Jones, M.A., M.D.; Professor James Clerk Maxwell, M.A.; *Professor William Pole, C.E.; Archibald Smith, Esq., M.A.; Professor Henry J. Stephen Smith, M.A.; *The Earl Stanhope, P.S.A., D.C.L.; Professor James Joseph Sylvester, M.A.; *Thomas Watson, M.D., D.C.L.; Professor Charles Wheatstone, D.C.L.; Rev. Professor Robert Willis, M.A. The Fellows whose names are preceded with an (*) were not Members of the last Council. The President delivered his anniversary address. The Copley medal was awarded to the Rev. Professor Sedgwick for his geological discoveries, extending over a period of forty years. A royal medal was presented to the Rev. M. J. Berkeley for his contributions to botanical sciences, and especially to fungology. The other royal medal was awarded to Mr. J. P. Gassiot for his researches in electricity.

THE WONDERS OF THE WIRE.—The French Emperor's speech on the opening of the Session consisted of 2,044 words. The transmission by telegraph from the central station at Paris commenced as soon as it was ascertained that the reading had been completed, which was at about half-past one. The average time occupied in transmission to the principal cities of France and Europe was an hour and a quarter, or at the rate of 28 words per minute. The capitals for which the longest time was required, from the want of a direct communication, were Rome, St. Petersburg, Athens, and Lisbon. The speech was nevertheless received everywhere before the evening, and the journals of the whole of Europe produced it on the following morning the same as those of Paris.

PEAT.—A PROPOSED NEW INSULATOR.—The deposit of peat in Great Britain and Ireland occupy an area of not less than 6,000,000 acres, chiefly composed of vegetable matter (fir and pitch trees). It is impervious to water when manufactured in solid cakes—112 lbs. of *hydro-carbon* or peat grease is drawn from one ton of peat (used for lubrication, &c.) There are other and novel applications of peat that will give incalculable value to an article which has often been considered worse than useless in this country, and the supply of which is boundless. By passing the peat through a conical strainer it is immediately converted from rude lumps of fibrous mud into a homogeneous mass of the consistency of putty or dough. By placing a similar strainer, with smaller and more numerous perforations, directly under the other, letting the vermicular peat drop from the upper strainer into this lower one, and working the two strainers simultaneously, the peat is so perfectly tempered that it can be moulded into the most delicate forms, forming a substitute for wood, ivory or bone, gutta percha, clay, or plaster of Paris, in the manufacture of an immense number of articles. Its specific gravity is thus raised to 1·25, and its density and strength are so great that it may be applied to some purposes for which stones or iron is now employed. The twice-strained peat has all the appearance of ebony, and when rubbed it acquires a beautiful lustre.

EXPERIMENTS MADE FOR ESTIMATING THE TEMPERATURE OF THE SEA AT VARIOUS DEPTHS.—In latitude 24° 40′ S. the heat of the air was 72° 5′, of the water at the surface 70°, and of water at the depth of eighty fathoms 68°; August 27, 1772. Latitude 58° 21′ S. the heat of the air was 31° 5′, of the water at the surface 32°, and of water from the depth of 160 fathoms 33° 5′; December 27, 1772. Latitude 80° 30′ N. the heat of the air was 32°, of the water at the surface 36°, and of water fetched up from the depth of sixty fathoms, under the ice, 39°; August 4, 1773. Latitude 75° N. the heat of the air was 66° 5′, of the water at the surface 55°, and of water at the depth of 683 fathoms 40°; September 4, 1773. Sir James Ross, upon being examined before the late submarine telegraph committee, gives a very interesting account of the experiments made by him with regard to the temperature of the sea in southern regions. Sir James states that the results were symmetrical, and followed a clearly established law, which he explains as follows:—"During the many thousand years that the earth has revolved on its present axis, the ocean has been absorbing heat from the sun, especially at the equator, where its rays are most powerful. There the temperature of the surface of the sea at the present time is about 80°; this temperature diminishes very rapidly in descending below the surface of the few hundred fathoms, and then very slowly to a great depth. Thus—

The surface temperature is			80° 0′
At 150	fathoms below	the surface	54° 0′
300	do.	do.	46° 0′
450	do.	do.	44° 0′
600	do.	do.	42° 8′
750	do.	do.	41° 4′
900	do.	do.	40° 8′
1200	do.	do.	40° 0′
1500	do.	do.	39° 5′
1950	do.	do.	39° 5′
2100	do.	do.	39° 5′

This temperature of 39° 5′, Sir James believes, continues to the greatest depth, and which he calls the normal temperature of the ocean.

PRINTING BY TELEGRAPH.—Some interesting experiments with printing inks have just taken place at Miss Faithfull's printing establishment, the object being to test the utility of ordinary printing in telegraphy. An Italian gentleman has invented a process of printing by telegraphy which appears to take less than half the present time of transmitting a message. Every kind of printing ink have had their trial, some with very good success. The specimen printed by the process, transmitted from Liverpool to London, is before us, and appears completely successful. The Lord's Prayer, composed and printed at Miss Faithfull's office, and forwarded to Liverpool, is stated to have taken nearly two minutes and a half.

THE comparative electromotive force and liquid resistance of various forms of battery used in telegraphy, as determined by experiments by Captain Shaw, R.E., and Lieutenant Fowler, R.E., are as follows, in miles of resistance of No. 16 pure copper wire:—

	T.	L.
Graphite battery, plates 6′ × 2″	4·56	·38
Ditto in action for two days	4·96	·63
Muirhead's Daniel's plates, 4′ × 2″ and 4′ × 3″	4·36	·85
Ditto (greased cells) ditto	4·34	1·24
Chatham battery, plates 4′ × 1″, cast zinc	4·25	·84
Sand battery, plates $3\frac{1}{2} \times 4\frac{1}{2}$, freshly made up	4·56	·53

[T., the electromotive force or tension; L., the liquid resistance, or resistance to the passage of the current of electricity from the zinc to the copper.] The liquid resistance vary with the sizes and arrangements of the metals opposed to each other in the batteries, but will always be greatest, *cæteris paribus*, in those which require porous cells; hence the reason will be apparent why the force circulated by the small battery used for the R.E. telegraphs is equal to that derived from the large Muirhead's battery with the porous cells.

TELEGRAPH IN COCHIN CHINA.—A fact worthy of remark is, that, at the commencement of the insurrection, the rebellious Annamites left our lines of telegraph intact, a circumstance which can only be explained by the ignorance in which they were regarding their purpose, and the power which the telegraph added to our means of action; we have seen how, by means of it, the military authority had been able, from the 17th December, to give the alarm; it rendered it possible to follow day by day, and hour by hour, the progress of the insurrection, and to send reinforcements to the points most menaced. During the attack on the fort of Long-than, situated on the route from Bien-hoa to Baria, the superior commandant of the province, installed in the bureau at Baria, at a distance of forty kilomètres, directed the defence, and prescribed the sorties, according to the information (renseignements) he received. But the facilities resulting from the preservation of the telegraph were not left to us until the end, and, in the first days of January, 1863, the Annamites, better informed, broke the precious instruments which, until then, they had despised; 100 kilomètres of the lines were destroyed, especially those from Long-than to Baria, and from Cholen to Mytho, in places (centres) which had not been completely explored, and where numerous (beaucoup de) bands had sought refuge. It was necessary to await the re-establishment of peace, to repair the injury, but, wherever the lines were left intact, the telegraph remained until the end, a useful auxiliary to the government of the colony. The Administration of Marine, in proposing for the decoration of the legion of honour, the chief of the mission, believed it due to render a special testimony to the assistance which the telegraphic service had lent it:—"The Vice-Admiral, governor and commander-in-chief in Cochin China," said the Minister of Marine, "has informed me, that, in spite of numerous difficulties, the *personnel* of the telegraphic lines had attained, during the course of the year 1862, the completion—with the exception of the line from Baria to Cape Saint Jacques—of the great principal net-work of electric communication in lower Cochin China, as well as the establishment of some of the branch stations (succursales). In pointing out to my attention, the zeal and intelligent devotion, of which the *employés* of the telegraphic service have not ceased to give proofs since their arrival, the Vice-Admiral Bonard recommends, in a most special manner, M. Hudot, director of transmissions, chief of this important service, whom he proposes for the Cross of the Legion of Honour."

RECENT PATENTS.

963. R. KNIGHT, Dunkirk, France, "Treating and preparing iron, copper, and other wires for telegraphic and other uses, for the purpose of preventing them from corrosion or decay."—Dated 17th April, 1863.

The patentee claims treating and preparing iron, copper, and other wires for telegraphic and other uses by coating such wires with pure tin, and condensing the same thereon by any suitable mechanical means, as described, for the purpose of compressing or condensing the coating of tin when applied on the surface of metallic wire, in order to so completely close up the pores of the tin as to prevent the coated wire from being chemically acted upon by acid or other solutions, or from the oxygen of the atmosphere, or from other atmospheric, gaseous, aquæous or submarine influences.

A. BROOMAN, Fleet-street, London, "Laying submarine telegraph cables in communication." Dated 13th May, 1863.

This invention consists in connecting to the cables as they leave the vessel from which they are paid out, buoys filled as hereafter is explained, and which after a certain time lose their buoying properties, whereby a nearly consistent tension is maintained on the cable. In addition to the buoys, in some cases heavy weights are attached, and cause the cable to descend to the bottom of the water in which it is being submerged. The buoys are by preference in the form of balloons of caoutchouc or waterproof cloth, and when not extended occupying but a little space in the vessel. These buoys are provided with a tap in which there are two ways, one for the admission of air and the other closed by wire gauze for the escape of air; the wire gauze is covered with gum, or other material which will dissolve after exposure to the water, and according to the nature and thickness of those coverings so will the air escape more or less quickly after the balloons have been submerged. The balloons are attached to a cord, the lower end of which carries a weight, and as the cable is leaving the vessel the balloons are attached by throwing and twisting the weighted end of the cord round it. Instead of balloons, or together with balloons, buoys in the form of parachutes may be attached to the cable in a similar manner to the balloons.

PRICES CURRENT OF INSULATING MATERIALS.

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities.	2/3 to 2/6 per lb.
Good re-boiled	1/7 to 1/10 „

INDIA RUBBER.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/1 to 1/2 „
Java and Penang	1/4 to 1/6 „

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	58 to 63	—
Stock	Electric Telegraph	100	105 to 108	—
100	Submarine Telegraph, scrip.	all	40 to 50	—
all	Do. registered	all	3/8 to 5/8	—
5	United Kingdom Telegraph	8	$\frac{3}{8}d$ to $\frac{1}{2}d$.	—
	Mediterranean Extension Tel.	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
	London District Telegraph Co.	all	$1\frac{1}{2}$ to 2	—

TO CORRESPONDENTS.

SCOTTISH VULCANITE COMPANY *v.* BENDER.—A full report of this important trial will appear in our next number.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

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THE TELEGRAPHIC JOURNAL.

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PRACTICAL TELEGRAPHY.

PRACTICAL men are very apt to despise science, and think that theory and practice are diametrically opposed to one another. Nor are students entirely free from a similar failing; they are too apt to affect a superiority over practical men, to ignore the results they have arrived at, and to exclude such results from their works.

Almost every one who is engaged in telegraphy is a practical man; there are few who have studied the science of electricity; many who believe that "book-learning" is of no use; and, it must be confessed, that of the two, an imperfectly-educated practical man is far more useful than one who has a mere smattering of science; the first knows only what he has actually seen, the second may have seen nothing, and have learned nothing accurately from his books. What little the former knows is, as far as it goes, valuable; what the latter fancies he knows is, probably, worthless. The truly useful man is he who combines both theory and practice, who understands the reason why he acts, and can check his reasonings by his knowledge of actual results.

The starting of a second journal, principally devoted to the telegraph, gives us an opportunity of assuring our practical men that they would be benefited by studying theory. Let them look around them, and see who are filling the most important positions in the service. Are they not, firstly, those who, with a talent for business, and for placing themselves prominently before the public, possess also a thorough knowledge of the science of their profession; and, secondly, those who combine the knowledge of the theory, with experience in practice, but who are deficient in the pushing quality of the first. No man can rise to the first rank in any department of applied science, unless, indeed, he be a man of extraordinary genius—unless he combine science and art.

"Rule of thumb" is of no use in new circumstances. A merely practical man, who knows nothing but what he has seen with his own eyes, can scarcely divest himself of a prejudice in favour of what he has been accustomed to, and especially of what he used when all was fresh and wonderful to him. Thus men are to be found still, who consider nothing can be better than the old *cones* and *winders* of their early days; and who, in spite of the clearest evidence, still dislike *earth wires*. We well remember, also, that there was the greatest difficulty in introducing the printing system; the practical men stuck to their double needles. Yet who would now regret the change?

It may be strange that in an art not twenty years old there should be Conservatism, but nevertheless it is so, and there are many who detest novelties, not because of the trouble they have in comprehending them (for they are real practical men to whom a new instrument is a puzzle), but because they are *innovations*. Such men generally complain that they are badly paid, and desire that society, and things in general, shall be reformed and reconstituted.

Then, had there been no students, no scientific men, where would have been our progress; nay, where would have been the telegraph itself: it surely was not invented by our merely practical man.

But the men of science must also permit us to say that, had it not been for the men of practical observation and active work, there would have been but little improvement. Our books, if written by men of no experience, are apt to mislead. It is most difficult, perhaps impossible, to arrive at all the bearings of a subject by mere thought or reasoning, even if its broad general truth is confirmed by experiment; especially so in our science, in which the experiments are on too large a scale, and too costly to be performed in a laboratory.

Hence the great utility to us of the scientific practical man.

For example, it is stated in scientific works that, in order to produce the greatest possible effect with a given surface of metals in a battery, the sheets should be cut into so many pairs as would, if arranged to the best advantage, be exactly equal in resistance to the rest of the circuit.

Now, if a telegraph battery were constructed on this principle, it would be found to fail. Is the theoretical statement incorrect? By no means—it is perfectly true. But, firstly, we do not require the *greatest possible* strength of current, but a current strong enough *to give good signals;* secondly, we want a battery which shall last for some time, without growing feeble; and, thirdly, one which shall make up for the current lost by leakages on the line. Hence the practical arrangement differs widely from the theoretical, as usually stated, because the subject is not considered in all its bearings in the scientific works referred to, and the statement, as it stands, is eminently calculated to mislead the practical man.

The *merely* scientific man is, then, a worse guide than the merely practical man, and the due mixture of science and experience has produced, and will always produce, men of the first rank.

Practical men then, study the science of your art, and enter a *profession*, new indeed, but honourable.

SUBMARINE TELEGRAPHY AS AN ENTERPRISE.

To say that Submarine Telegraphy is the greatest enterprise of the age, is to use a hackneyed phrase, which has now passed into a truism, and which, like a great many other indubitable hypotheses, runs the risk of becoming meaningless from frequency of repetition. It is a large expression nevertheless, and yet it may be rendered still more superlative, by insisting that it is not only the greatest enterprise of the age, but that it surpasses all others on record in any age.

Our present object, however, is not to reiterate that which, perhaps, few will gainsay, but rather to show that, apart from this consideration, it is an enterprise which offers rare advantages to those who are in a position to throw themselves into it.

Judging, however, from its present condition, and the tardiness shown towards the object by those who could really forward the work if they chose, to no inconsiderable extent, it might appear, to a casual observer, as being indicative of just the opposite of what we assert.

Of course every true lover of progress, and ardent enthusiast after that desideratum which they know to be practicable, must sincerely deplore such a state of lukewarmness; but fortunately, the consciousness that this is one of the trying ordeals through which all great designs and projects must pass, affords some gleam of cheerful hope that the dawn cannot be far off, while

past experience will inculcate a salutary lesson, and tend to restrain impatience.

At this time it will not, perhaps, be inopportune to dwell briefly on two points with respect to submarine telegraphic enterprise: first, that it is a safe, because practicable undertaking; and secondly, that it offers by far the highest return on the capital invested.

As regards the safety of such projects, it resolves itself into the question of success or non-success in the manufacture and submergence of a cable. It is to be regretted that a vast deal of dubiousness exists upon these points, and not altogether without cause; this must be removed; be it ours, therefore, to use such humble means as we possess to that end.

We do not share in this mistrust: we believe in the certain and invariable success of the submarine telegraphy of the future, and that too, without feeling ourselves chargeable with presumption. We have such confidence in our cable manufacturers now, that we feel perfectly certain they are competent to produce efficient, not to say perfect cables; and even were there cause for misgiving on this point, certain we are that our electricians and engineers are too honest, too jealous of their reputation, and concerned too much for the public good, to allow a submarine telegraph cable to pass as perfect, which had failed to stand the numerous and searching tests which, happily, the advance of telegraphic science has brought into use for that purpose.

We feel perfectly safe, therefore, in assuming that a faulty cable will never be permitted to pass beyond the curriculum of any electrician worthy of the name, hence failure can hardly originate in that quarter.

But, it may be urged, the most perfect cable ever made may be irretrievably injured in the paying out, and certainly it would be difficult to say how much of past mishaps are attributable to this cause. This is by no means necessary, however, unless we irrationally assume that past contrivances to this end represent the *ne plus ultra* of wise arrangements and mechanical skill. It is quite conceivable that machinery may be constructed so exquisitely adapted for the purpose as that the cable should be comparatively unaffected by whatever description of weather or rough sea it met with during the process of submersion. For the past three or four years, perhaps, as much attention and careful study has been devoted to this important subject as to any point that concerns the all-important matter of submarine telegraphic success, and, we may safely say, with results equally happy, and equally creditable to those gentlemen who have laboured so diligently at the praiseworthy and self-imposed task. The effectual and safe submergence of ocean telegraph cables need not, therefore, excite the smallest apprehension: it is a difficulty virtually overcome, and we can but sincerely hope that those who have helped to conquer the difficulty may speedily reap the substantial reward they merit.

Humanly speaking, success in submarine telegraph enterprise is a certainty.

In this part of our subject, it only remains for us to speculate upon possible adverse circumstances, over which, probably, we may have no control. And here we would throw aside all vain confidence and presumption, in presence of that Supreme Power "who hath measured the waters in the hollow of His hand, and meted out the heavens with a span," and humbly acknowledge that if He wills to the contrary, our best efforts to annihilate time and space will be abortive. Nevertheless, we know of nothing, at present, that transpires in the great deep, such as natural convulsions, of whatever character, that warrant us in indulging in prognostications of failure consequent thereon.

The mystery which enshrouds the fathomless abysses of ocean is, of itself, apt to be construed into plausible arguments that submarine cables can never be looked upon other than as doubtful ventures, with the probabilty of non-success vastly preponderating; but, assuredly, this is frightening oneself with unsubstantial chimeras. To assert that the plateaus of the undiscovered ocean beds are inimical to the safe deposition of a telegraph cable is, at best, but a gratuitous assumption, and so, for the matter of that, is the contrary opinion; but, in these things, we can only reason by analogy, and a train of inductive reasoning from observed phenomena to supposed phenomena beyond our ken, will, indubitably, be more favourable to the latter hypothesis than the former.

Except in cases of gigantic convulsions, in which we may suppose whole continents sunk and others upheaved, and the physical conformation of vast portions of the globe utterly changed, we know of nothing that would lead us to infer that, beyond a moderately fathomable depth, there is aught to be met with but a state of absolute repose; and, since by gravitation all denser bodies ultimately find their way to the bottom, it is inconceivable that that bottom should be rugged and flinty. There may be unknown dangers, of which at present we have no conception, but it is more probable they exist only in the imagination of the timid, or are the speculations of fire-side philosophers.

We will consider the second part of this subject in our next.

MR. C. F. VARLEY'S TRANSLATING APPARATUS.

MR. VARLEY has recently published, in the form of a small pamphlet, a description of the above ingenious and useful apparatus, now extensively employed on the lines of the Electric and International Telegraph Company, to which the inventor has long acted as Chief Electrician. These instruments were first constructed for working the International Telegraph Company's Dutch Cables, in 1854, to overcome the effects of the induction. The construction of the instrument is fully explained by numerous diagrams. One of the great advantages obtained by the arrangement adopted, consists in the relay being self-adjusting, owing to the system of working by the reversal of battery currents; consequently, the variation of the strength of the currents, from humidity of the insulators, &c., seldom necessitates any alteration in the adjustment of the relays.

The apparatus consists of two complete sets of printing instruments, each composed of a Morse machine, two relays, a spacing apparatus, two switches, a galvanometer, and a key. The two sets are connected with each other in such a manner as that either may be used separately as a terminal instrument, or the two combined as a translating apparatus; an operation performed in half a second, on either station giving the signal, D F.

The Morse machine is nearly similar to those in ordinary use for printing circuits, consisting of a pair of rollers put in motion by clockwork, carrying the strip of paper between them. In the upper one is a groove, in which the style or embossing point of the moveable armature plays. Under the pallet of the armature are placed the coils of an electro-magnet. When a current is sent through the coils the armature is depressed at one end and raised at the other; the latter carrying the style embosses the paper as it is drawn forward by the rollers.

The relays—one used for closing the marking circuit, the other for closing the spacing circuit—are composed of a horizontal bar electro-magnet, which is moveable within its coils, which are ordinary cylindrical ones, separated into two parts to allow the axis of the bar to pass through; each end of the bar plays between the poles of a permanent horse-shoe magnet, each magnet being similarly placed in respect to its poles. When a current passes through the coils the moveable soft iron core is deflected to the one side or the other, according to the way in which it is magnetized. When the current which is intended to mark the paper is sent through the marking relay, the bar is deflected against a metallic point, which is in connection, as shown in the diagram, with the zinc pole of the local battery, the bar itself being connected to the copper pole. When on the passage of a current through the coil the bar is deflected as above, the local circuit is closed; the armatures on the levers of the Morse machine and spacing apparatus being simultaneously drawn down, as hereafter explained.

The spacing apparatus consists of an electro-magnetic coil, with an armature and pallet supported on an axis above it, and furnished with two pillars, with adjusting contact screws to limit its upward and downward motion.

The line switches are for the purpose of dividing the line, if necessary, so that the translating station can communicate with any station on the up or down line separately. This is accomplished when the switch handles are turned to the right (I Q). When in the other position, viz., to the left (D F), the keys are taken out of circuit, and both line wires are connected to the translators, so that the distant stations can communicate with each other.

When receiving a message, or translating, the handles of the key switches are placed to the right (*receive*); but when signals are required to be sent by the translating station, the handles must be turned to the left (*send*).

The galvanometers are provided with two separate coils of wire, so that the outgoing current, which is strong, may pass through only a short coil, and the receiving current, which is comparatively weak, through a longer one, thus making the galvanometer show the force of either current. The shorter coil may be cut out of circuit entirely by the insertion of a plug provided for that purpose.

The keys are used for the transmission of currents either way, when the line switches are at "I Q," and the key switches at "*send*."

The induction plates are composed of lead or carbon, charged with diluted sulphuric acid, and when once charged require no renewal; this solution does not evaporate. They give no current themselves, but are capable of receiving an induced charge. If a galvanometer be inserted in the circuit immediately after passing a current through them, a strong deflection will be observed; but this will gradually decrease in strength until it nearly disappears, the use of these are explained further on.

The whole apparatus may be worked from one main set of batteries, or separate sets may be employed if preferred. If the former plan be adopted, the batteries must be unequally divided; the copper pole of the larger or positive battery, and the zinc pole of the smaller or negative battery, must be led to the apparatus, the other poles being put to earth.

Assuming, then, that the up station is transmitting a current along the line, and also that the line switches are turned to the left (D F), in a position for translating, and let the current be a marking one (*i.e.* a positive current) coming from the up line it enters the shorter of the two separate coils of the galvanometer of No. 1 set, thence it goes to the line switch, from which it passes passively through the Morse machine and the spacing apparatus of No. 2 set, and back to the marking relay of No. 1 set, through the coil of which it passes; thence it goes through the coil of the spacing relay in a reverse direction, and finally passing through the longer coil of the galvanometer, it makes its escape to the earth.

In passing through the coil of the marking relay of No. 1 translator, the current deflects the armature, and closes the local circuit, which causes the armatures of the Morse machine and spacing apparatus to descend simultaneously. The armature lever of the Morse machine being connected, through the galvanometer and line switch, with the down line, and the pillar which limits the downward motion being connected to the copper pole of the relaying battery, when the armature descends a current is transmitted on to the down line, marking the paper at the distant station. During this time, although the armature of the spacing apparatus has been drawn down, it has sent no current; but when the armature of the Morse machine is released by the sending station reversing the line current, the spacing apparatus comes into play and transmits a current the reverse of that before sent by the Morse machine.

The local circuit is arranged thus:—When the armature of the marking relay is deflected, the current from the local battery passes through the coil of the Morse machine and that of the spacing apparatus, and through the induction plates. On its arrival at the latter it is divided, one portion going through the coil of the spacing apparatus, and the other portion through the induction plates, which are placed in a loop on the coils of this part of the translator. When the distant station reverses the current, by allowing his key to ascend, the armature of the marking relay is deflected back to the non-conducting point, breaking the local circuit, in consequence of the line current traversing the coil in a contrary or reverse direction; but as the line current passes round the spacing relay in the opposite direction, the armature of this relay is now deflected, and permits the current from the local battery to pass through the coil of the spacing apparatus and the induction plates only, when the armature of the spacing apparatus only is depressed, while that of the Morse machine is elevated, connecting the down line to the zinc pole of the smaller battery. In this way reverse currents are translated from station to station.

The use of the induction plates is this:—When the local circuit is broken, the induced current from the leaden plates holds down the armature of the spacing apparatus for a short interval, and thus prevents it rising during the reversal of the current.

To recapitulate:—When a distant station transmits a marking current (copper, for instance), the armature of one of the relays is actuated, and the local current passes through the coil of the magnet of the Morse machine, and then divides itself between the coil of the spacing apparatus and the induction plates, the Morse machine transmitting a copper current on to the distant station. During this time the spacing apparatus is ready to perform its part in sending on a negative current, but cannot do so until the sending station reverses his key: this done, the armature of the spacing relay is then deflected, and allows the spacing apparatus to act alone, and transmit a zinc current. By the addition of the induction plates to the coil of the spacing apparatus the armature is kept down and in readiness to send the zinc current, instead of retiring at each break of the line current as it otherwise would do.

These instruments, at a station, are connected to a universal switch, called an "Umschalter," and thus, in less than two seconds of time, any two circuits can be linked together. This invention has considerably reduced the cost of transmitting messages across the country, and has, by reducing the number of hand transmissions, reduced the number of clerical errors, besides expediting the rate of transmission. For example:—a message between Windsor Castle, and Her Most Gracious Majesty's abode at Balmoral. The electric current from Windsor goes to York, and thence to earth; the York translator sends on a new current to Edinburgh, which goes to earth there; the Edinburgh translator sends on a third current to Aberdeen, and the latter station translates on a current to Balmoral, which station speaks as easily with Windsor Castle as if it were only twenty miles distant. Balmoral station is able, in the same way, to speak to Amsterdam, and there, by modification of the instrument, just described, the reversed current system of Mr. C. F. Varley, is translated into the single or ordinary Morse system, and *vice versâ*, the single current system of the Continent is most ingeniously made to call into play the reversed current system of Mr. Varley.

The operators in Great Britain do not perceive the break, nor do the telegraphists of the Continent know, except by book, that such a break exists as Amsterdam. The detail of this early and curious invention, necessary to meet a great public want, and to put all the vast continental network of telegraphs in direct communication, with the condensed, but extensive system of the great pioneer company, cannot be attempted on this occasion, and it would require considerable acquaintance with the subject, to enable the reader to follow the apparently complex, but, in reality, simple contrivance to overcome the difficulties which present themselves.

At the Manchester British Association meeting, that town was, during the great "Soirée Scientifique," put in direct communication with St. Petersburg, Odessa, Taganrog, on the Sea of Azof, and with the frontier of China, the transmission across 4,000 miles of wire occupying not more than two seconds of time.

MR. R. S. CULLEY'S NEW WORK.*

(*Continued from p.* 3.)

THE most interesting, if not the most important, branch of electrical science to the practical telegraphist is that of insulation, to the consideration of which Mr. Culley has devoted the fourth part of his book. The humidity of the atmosphere is the greatest enemy the telegraphist has to contend with. All the resources of the fertile minds of our most eminent electricians have been directed towards the mastery of the effects of moisture. It is easy to obtain materials which, in their powers of resistance, are sufficient to pro-

* A Handbook of Practical Telegraphy. By R. S. CULLEY, Telegraphic Engineer and Superintendent. London: Longman, Green, and Longman.

duce an effectual bar to the passage of the current from the conductor to the earth, but this power of resistance is immediately nullified on the first deposition of moisture on their surface. The earliest insulator practically applied was an ordinary goose-quill, but this was speedily found inoperative, and replaced by brown earthenware. Various shapes, rings, cones, umbrellas, *et hoc genus omne*, in this material and in glass, while porcelain, ebonite, &c., have been successively applied at various periods of our progress, and insulators, at first considered almost perfect, have been substituted for others still more perfect, and even now there is great room for improvement. An historical account of the various steps of the insulator would be extremely interesting, but Mr. Culley has carefully abstained from dealing with this branch of his subjects. He has contented himself with detailing the various obstacles to be surmounted, and the causes of failure and interference:—

The insulation of a line is never perfect, even in dry weather. There is a loss at every point of support, even when the insulators are clean, and this is considerably increased when their surfaces are damp, more especially so when dusty, dirty with smoke, or salt from being near the sea. When the wires are not galvanized, a slight coating of rust is formed upon the insulators by the rain dropping from the wires; this is very hurtful. The wires are often hung with spiders' webs, which, when covered with dirt and moisture, conduct; and on a long line the leakage from wire to wire through damp air cannot be altogether without effect. Though it may be extremely small at any given point—so small, indeed, that the tests hitherto made have failed to discover any conduction whatever—yet the total surface exposed is enormous, being as much as 220 square feet per mile of No. 8 wire. A very rough test will show how much insulation is affected by dirt or smoke, and too much care cannot be taken to keep the insulators clean.

As damp affects insulation so seriously, great care was taken in the earlier telegraphs to protect insulators from the rain by wooden roofs; but it has been found that such coverings are not only useless, but injurious. They do not themselves insulate, they afford no protection in fogs or continued rain, for then every part becomes equally damp. They harbour spiders, which spin their webs over and among the wires. They hinder the drying of the supports, and prevent the rain washing off the dust which covers the insulators. The inside of a hollow insulator, or that part which is protected by a wooden arm, is always dirtier than those parts which are fully exposed, and damp dirt conducts far better than a film of dew or clean rain water. Insulation is frequently improved by a heavy summer shower. There is a great disadvantage in placing insulators under bridges, where they are quickly covered with smoke, and are protected from the cleansing effect of rain. The umbrella-shaped insulator secures all the advantages of the roof in keeping an insulating surface dry in moderately wet weather, while it adds to its insulating power by increasing its length.

He has shown—though, perhaps, not in the most mathematical or elegant style—that surface, as was once considered, is not the most effectual means of improving the resisting powers of an insulator. As he remarks,—

The best insulator is that which has the smallest diameter, with the greatest length of surface between the wire and the bolt, or support. Length is most easily given by hollow or cup-shaped insulators placed inside each other.

The affinity of a material for moisture, or its power to attract damp, is an important point. Glass, though a better insulator than porcelain, becomes damp much sooner. If a glass tumbler and a teacup, each filled with cold water, be brought into a damp warm room, the glass will be covered with dew long before the porcelain shows any signs of moisture. The glass supports of apparatus used for experiments on frictional electricity must be varnished with shellac, to lessen this affinity for moisture.

Ebonite insulates much better than glass, and is far less apt to become damp than even porcelain. It is the best material yet known for insulation, but we have not had sufficient experience of its durability to judge of its power to bear exposure to the weather.

He has devoted considerable space to the investigation of the effect of leakage, or bad insulation at various points of the circuit, upon the received signals, and the effect of increasing the battery power by reducing the internal resistance of the battery, or adding to the number of cells upon the strength of the received current. He has by no means exhausted this branch of the science, and much remains to be written upon the ill effects of rain, fogs, and moisture in general, upon the insulation of our lines.

The philosophy of *Induction*, which is discanted upon in the fifth part, is more interesting to the submarine than to the land telegraphist; yet it is one which every practical man should thoroughly understand. Owing to the almost universal abandonment of underground wires of any considerable length its effects are rarely visible but on submarine lines; still, a knowledge of inductive effects assists immensely in the comprehension of numerous peculiar phenomena daily observed on circuits and in instruments. Induction is a very peculiar action, and requires great study to master. Experiment alone will lead to its thorough knowledge. Mr. Culley's remarks will, however, materially assist the student.

This part concludes with a short account of the disturbing effects of atmospheric electricity, and a description of that unaccountable and extraordinary phenomenon termed "Deflections:"—

"DEFLECTIONS," OR "EARTH CURRENTS."

Occasionally, especially during the aurora borealis, strong currents—sometimes steady, at other times changing their direction very rapidly—appear in the wires. These currents are not caused by atmospheric electricity, for they cease if a wire be disconnected at one of its ends, and they appear equally in buried as in suspended wires. They seem rather to be caused by currents flowing from one part of the earth to another, which enter the wires by one of their earth connections and leave them by the other, when the currents happen to be passing in that direction.

The wires are constantly traversed by these currents, but it is only at times that they attain sufficient force to affect the apparatus.

They appear most frequently, and have greatest power, on lines lying N.E. and S.W.; but it appears that the direction of the current changes with the hour of the day, so that one line may be more strongly "deflected" in the morning, another in the afternoon.

The current has frequently been seen to leave one circuit and to appear upon another previously free.

Communication may be kept open by the use of a magnet, to counteract the effect of the current. But when deflections are very strong and very variable in direction, the best method is to disconnect two wires from earth at both ends, and to use one as a *return wire* to the other in place of the earth.

(*To be continued.*)

TELEGRAPH PROPERTY.

(*Continued from p.* 5.)

THE tendency of the present day is decidedly to cheapen everything. Telegraphs and telegrams must consequently follow the general rule. Before, however, an article can be advisedly cheapened, there are two essentials. One is that the cost of manufacture be reduced, and the other that the consumption be proportionately increased. We may safely state that telegraph property falls within these two contingencies.

The manufacture, or rather the construction of telegraphs, has been considerably reduced in cost since their first introduction. The chief cause has been the expiration of the principal patents under which the original telegraphs were constructed, whilst the increase in the number of contractors for this description of work has, no doubt, assisted in the same direction. We believe we are within bounds in stating that work which used to be valued at £40 per mile would now be readily undertaken at little more than half that sum. The same reduction has also been experienced in the cost of the various descriptions of instruments. The heavy cost of the works to the older companies will, doubtless, find an adequate set-off in the comprehensive system which they have been enabled to establish during the existence of their patents, whilst, although the more recent companies will have the advantage of cheaper construction, they will have to make their lines and obtain their traffic in the face of existing competition.

Judging, however, from the official returns which were published in this journal last week, it is tolerably evident that a sufficient demand and inducement exists for increased means for telegraphing, and it is probable that the greater the facilities that are offered the more they will be appreciated.

We could not, however, for one moment suggest a reckless competition as to tariff; in such cases the public are temporarily benefited at the probable permanent cost of the telegraph companies.

The tariff for telegrams has, as a rule, been fixed on the mileage principle and in proportion to the capital expended. This was, no doubt, the correct basis, the probable amount of business between the various stations being also taken into consideration.

The preliminary cost of the construction of telegraphs having thus been reduced, and the natural progress of the period having led to an increased use of the telegraph, it is a necessary consequence that we must look forward to reduction in charges, which there is every reason to believe will be more than compensated by an increased number of messages.

(*To be continued.*)

TO ERECT A LINE OF TELEGRAPH.

In obedience to the wishes expressed in our last, we propose to give in a popular form such instructions as must prove of value to those who desire to obtain the requisite knowledge of practical telegraphic engineering. As the aspirant must commence with one branch at a time, the line, battery-room, machinist's shop, or steamboat (for submarine cable work), is each open to his choice, and, no doubt, he will first select the line, especially if he has hitherto been confined to the signals department, which has enabled him to become partially acquainted with the instrument and battery, their form or construction, and their use.

It is questionable whether, in first selecting the line, his choice will be as wise as it may be delightful, but he will find much to amuse as well as instruct him, and this being the case, he is more likely to follow up his employment since it is a means of affording him pleasure.

When an engineer starts to erect or lay out a line of telegraph, he is not always the pioneer. There is a difficulty in his way called the "way-leave," and as much depends upon this, some words must be passed upon it. When, as in the case of the large English telegraph companies, agreements are made with the railway companies, the bogey "way-leave" is settled mainly by the directors, the secretary, and their chief officer, L.S.D., Esq., and thus the engineer has nought but plain sailing. When the London and North Western Railway Company first established the telegraph system over their lines, they not only gave an exclusive right of way to the Electric Telegraph Company, but paid them handsomely for the railway telegraph to be erected for the partial use of the Railway Company. This was a "way-leave" worth having, for it gave the Telegraph Company a positive power to prevent others from occupying the same ground, and for more than five years London had but one line of communication to Birmingham, Liverpool, Glasgow, &c. It was in vain that the British Electric Telegraph Company, formed for working Highton's valuable patents, endeavoured to force their way over the London and North Western or other railways; they offered to pay a "way-leave," and do the telegraph work for nothing, but (and it is with the view of showing the importance and the difficulty in getting a right of way that this is mentioned), failing on every side, they, in August, 1851, decided upon applying to Parliament for both road and railway powers.

At the present day the railways are pretty generally occupied, and though some of the telegraph companies obtained compulsory road powers, and these were freely used by the British Telegraph Company, Parliament has now given general powers, under the Telegraph Bill of last Session, to every company having a special Act of Parliament, and thus this difficulty is (though by no means got over) set upon a decided footing. The Act is sufficiently explicit to render it unnecessary to enter into the question of how to set to work, either by giving the legal notices, placing the works in defined positions, or by avoiding erecting the line in such a way that it may have to be removed at the bidding of any small tenant on the way. A great deal may be learned by perusing the Act, and it is therefore advisable that any one who contemplates studying for the line, should make it his first duty to purchase the Act, which can be obtained from any law stationer, price 1s. 1d., post paid, and carefully note it from beginning to end. When this is done, great pains must be taken to conciliate the road surveyors, trustees, landowners, and others on the route laid out for the proposed line. If you purpose to go underground the difficulty is not so great, but we at present have to deal with an overground line upon poles. We have found it of great assistance to be prepared with a small model of the line, and with instruments and batteries, such as are to be used, and that a lecture given in local schoolrooms, or in the Town-hall, if the place can boast of one, is a sure means of making friends, and of clearing the way before you. Only induce the landed magnates to take the chair, and they will be sure to contribute their aid and patronage sufficiently to enable you to progress with your work so far. Little places as well as large ones require care, but the parson of the village church who presides is no less help than the landed squire, for he has it in his power to still many a troubled wave; and if he is a decent fellow—and most parsons are decent fellows—he will give you a lending hand, and a strong one too. In this way the writer of these lines passed through a length of 174 miles, and erected his line of telegraph not only unresisted, but with facilities given to him with a degree of good nature perfectly astounding, when it is considered without prejudice how much a line of telegraph disfigures a pretty country.

If once the way is clear, the survey may proceed, and, with due care, this should be made so complete as to save much difficulty and trouble in the construction and future maintenance of the line. On a railway, small stakes should be driven in, to mark the spot where each pole is to be placed. These can be purchased, for 7s. 6d. per 100, of any lucifer match dealer; they may be made of common deal, 1½ inch square, by 18 inches in length, and it will often be found useful to have some rounded for special "marks," as, for instance, testing posts where shackles are to be inserted, or where branch lines diverge, and to check the number of poles, at stated intervals, by the survey book. They serve to keep a distance check, too, on all the stores, time, labour, and expenditure, when the construction begins. On highways, these stakes cannot so well be used; they are more subject to be removed, or to be in the way of the traffic. In this case a mark on a wall, like a broad arrow, or a small streak of lime, or paint, will answer the purpose, but if the stakes can be used in hedges, so much the better.

The appearance of the line will be greatly benefited by keeping the poles as much as possible in a straight line, and with the tops level one with the other. Nothing looks so bad as to see the wires rising and falling at every cross-road or gate-post, and, after all, it only saves a few feet of timber in each case, so it is not worth while to spoil the look of the work, by an endeavour to save a few pounds in the prime cost. The poles should be, in every case, 28 feet in height, or, better still, 30 feet, for this will give room for six wires, resting on three arms, leaving eight inches of pole above the top arm. If the pole is set in the ground five feet four inches, and the arms are ten inches apart, there will be a space of 22 feet four inches between the road and the bottom arm, and, including the height of the insulator, 23 feet between the roadway and the lowest wire, and this is ample to permit a load of hay, or one of Wombwell's wild beast shows to pass under. These are the only impediments that have come to the writer's knowledge, so far as height of line is concerned. Place your poles, on an average, 70 yards apart, if on a railway, and not more than 60 yards apart, if upon the high road. On a railway, as you prefer going over all tunnels and bridges, make your ground on the top of cutting embankments, and, when you come to level ground, or earthworks, keep as far from the metals as possible, always bearing in view that uniformity already alluded to.

(To be continued.)

THE INTERNATIONAL EXHIBITION, 1862.

The Report of the Jurors appointed to adjudicate on the various contributions to Class XIII., consisting of telegraphic materials, electrical and philosophical instruments, recently published, is one of considerable importance to those engaged in their preparation and manufacture; and its reproduction in our columns will doubtless be acceptable to our readers generally, and probably we shall have occasion frequently to refer to the facts and opinions contained and expressed therein.

The onerous duty of compiling the Report was entrusted to and ably performed by Mr. Fleeming Jenkin, C.E., the Associate Juror and Reporter. The following is a list of the Jurors:—Sir David Brewster, K.H., F.R.S., Edinburgh, Principal of Edinburgh University; Charles Brooke, F.R.S., London, Surgeon to Westminster Hospital, 16, Fitzroy-square; Dr. Dove, Chairman, Zollverein, Professor of Natural Philosophy, and Principal of the Academy of Sciences, Berlin; J. P. Gassiott, F.R.S., London; James Glashier, F.R.S., London, Superintendent of the Meteorological and Magnetic Department, Greenwich Observatory, Greenwich; Colonel Sir H. James, R.E., F.R.S., Superintendent of Ordnance Survey, Southampton; G. Carston, Denmark, Professor, Kiel; Edward Kraffs, Austria, Member of the Council of Civil Engineers, Vienna; Mathieu, France, Member of the Institute and of Bureau of Longitude, Examiner of the Polytechnic; Carlo Mettencci, Italy, Senator; Major-General Sabine, R.A., F.R.S, London, President of the

Royal Society; W. Thompson, LL.D., F.R.S., Professor of Natural Philosophy, University of Glasgow; C. Wheatstone, F.R.S., London, Professor of Experimental Philosophy, King's College.

REPORT ON ELECTRICAL INSTRUMENTS.

By FLEEMING JENKIN.

THE following Report is divided into five main heads or chapters. The first is introductory, and contains only general reflections suggested by the instruments exhibited. In the four remaining chapters the instruments are described in detail; a classification under four main heads, according to subject matter, has been adopted chiefly to facilitate reference to any particular instrument or class of instruments. With the same view, each main head or chapter has been subdivided into sections, each containing some special group of instruments. The sections, or subdivision of the introductory chapter, may be considered as so many separate introductions corresponding to the separate chapters.

It is hoped that this arrangement, according to subject matter, will be found convenient. Its defects are that it separates the instruments shown by each exhibitor, and that the order in which the instruments are described in no way corresponds to the order in which they appear in the catalogues, nor to the country from which they are sent; but, on the other hand, it has the great advantage of bringing all similar instruments together, facilitating description, comparison, and future reference. It also allows the various groups to be coherently placed.

1. *General Remarks.*

THE electrical instruments now exhibited are numerous and excellent, whereas in 1851, the Jury Report states that they were but few in number. On that occasion, moreover, telegraphic apparatus were contributed by only two foreign exhibitors, while a fair proportion of those now shown have been sent from abroad.

The past eleven years have not been marked by any great discovery in electrical science, nor by any very important novelty in the practical applications of its principles. We have to register no such marvellous invention as the electric telegraph, nor any new motive power superseding steam. On the contrary, it must be acknowledged that many sanguine anticipations in this direction remain unfulfilled.

We have, on the other hand, to record a great extension of the telegraphic system, and especially the introduction of submarine cables. We have also to describe considerable improvements in all telegraphic apparatus, and various excellent applications of electricity to philosophical and practical purposes. There is cause for satisfaction in the fact that scarcely any bad and few indifferent instruments are exhibited. The workmanship is generally excellent, and in almost every case the design is based on a clear perception of the nature of the duties which can be advantageously performed by electrical means. Thus, whenever the electrical current is unavoidably employed to do work, as in releasing the escapement of clockwork, or in propelling the index of dial instruments, it will be found that in the instruments now shown, the work is reduced to a minimum by admirable workmanship, and by the lightness of those parts which are alternately at rest and in motion.* On the other hand, wherever mechanical effect, or, as some would call it, actual energy, is employed to develop electrical effects, as little work as possible is wasted. With this view, care has been taken to diminish the weight and friction of the moving parts; rapid or frequent alternations of rest and motion have been, where possible, avoided; and the relative resistances of the various parts of the circuits used have in many cases been carefully adjusted. The absence of useless though specious inventions is illustrated by the fact that electromotors, or machines for the production of motive power by the voltaic current, are few in number, and quite unimportant.

The researches of Dr. Joule have shown that with the present prices of materials, it would be utterly vain to expect that the power to be obtained from the conversion of zinc into its sulphate, should compete economically with that resulting from the combustion of coal. Let a battery be invented in which a cheap material only is consumed, and it will then be time to consider which is the best arrangement for converting the voltaic current into mechanical effect. At present, on the contrary, both in the magneto-electric signalling instruments, and the magneto-electric light, we see the usual sources of power successfully used to produce various dynamic electrical phenomena. In facts like these we note the influence of that great and recent discovery, the definite and mensurable correlation or the equivalence of the various physical or natural forces. This discovery, which in future times will stand out clearly as the scientific triumph of the century, enables us to measure accurately the shortcomings of our combinations for the transformation of energy, by comparing the effect actually produced with the possible maximum; it thus both sets a limit to our expectations, and shows how nearly we have approached that limit. It has already swept away whole crops of foolish, baseless contrivances, and barred many paths of useless research; but although its indirect influence on the instruments we are considering is clear, we cannot point out any special invention or contrivance, which is its direct and immediate consequence. It is moreover to be regretted that no apparatus is exhibited for the exemplification and popular demonstration of those laws of correlation which are already firmly established.

* This excellence is perhaps carried to the highest pitch in Professor Wheatstone's dial instruments.

2. *Construction of Telegraphic Lines.*

The successful establishment of *submarine telegraphic communication* constitutes the most remarkable achievement brought into notice by the apparatus exhibited. In 1851, the possibility of such communication had been barely established by a correspondence maintained for some hours between Dover and Calais. Now, after many failures, nearly nine thousand miles of insulated and submerged wire are successfully at work, and a single manufacturer exhibits specimens of twenty-eight successful cables, varying from 2 to 1,500 miles in length. One specimen shows the bare insulated wire by which our armies in the Crimea were kept for some months in hourly communication with this country. A second shows the cable by which the Atlantic itself was traversed;—a great success marred by failure after a few weeks' work.

Gutta-percha, the insulating substance proposed, and to some extent used in 1851, is still found the best; and it is satisfactory to know, after eleven years' experience, that not one yard of submerged wire insulated with this material has been known to decay. The well-known failures of the Red Sea, the Atlantic, and some other cables, cannot be traced, as is sometimes supposed, to any inherent defect in gutta-percha.

Some failures have undoubtedly been due to flaws resulting from imperfect manufacture or manipulation, and some to mechanical injuries received afterwards; others have been caused by the absence of sufficient electrical tests for the timely detection of these flaws and injuries: but the greatest number of failures may be attributed to the corrosion of the outer protection of iron wires, which has invariably been accompanied by the breaking up of the cables into short separate sections, defying repairs.

One by one, these causes of failure have been discovered and eliminated, with such success, that the cables lately laid have thus far been uniformly successful. The electrical tests have especially been brought to great perfection, and indeed these researches into the electrical properties of the materials used as conductors, or insulators, and into the phenomena accompanying the transmission of signals, have been prosecuted with such diligence and success, that they may also be said to form a new branch of electrical science. The whole subject has been rescued from empiricism, and made the matter of accurate measurement and calculation. Daily, fresh discoveries are made, and fresh methods of investigation employed, and some of the most interesting instruments exhibited are connected with this branch of electricity.

India-rubber is the only material yet known which can be used as a substitute for gutta-percha in the insulation of submarine or underground wires. In 1851, India-rubber was condemned as unfit for this purpose, but since then its preparation has been so much improved, that it is now in some respects even superior to gutta-percha; but further evidence of its durability is required. A short cable, insulated by india-rubber, is about to be laid in the Persian Gulf; and india-rubber covered wire has been used for various purposes on land with considerable success.

It is worthy of remark, that the Dover-Calais cable, of which a specimen was exhibited by Mr. Brett in 1851, and which was laid in the autumn of that year, remains at work, and is still the type of all successful cables.

Land lines are now constructed much in the same manner as in 1851, with some improvements in detail. Their extension has been

enormous. Europe is now covered with a network extending to Constantinople, and past St. Petersburg and Moscow, deep into Russia, approaching China. In Europe it is calculated that there are now about 100,000 miles of line in use; and about 50,000 miles in the North American States. India in 1860 possessed 11,000 miles of wire, with 136 offices; in Australia there are between 4,000 and 5,000 miles in use.

In Great Britain the Electric and International, and British and Irish Magnetic Companies alone now own nearly 11,000 miles of line, and 50,000 miles of wire. In 1851, little more than 10,000 miles of wire had been erected. Private lines have also been established in several of our large towns. Their success has been chiefly forwarded by the admirable inventions of Professor Wheatstone.

Underground wires have been almost wholly abandoned, as in this position both gutta-percha and india-rubber have been found to decay rapidly.

(To be continued.)

TELEGRAPHIC MEMORANDA.

(Continued from p. 5.)

Telegraph companies victimised by professional "*smashers*." An individual—generally a woman—presented an "urgent" message, together with a counterfeit half-crown, receiving the change in current coin. The message, when delivered, was found in every instance to have been an impudent hoax, but was occasionally productive of considerable embarrassment to the unfortunate receiver. Stations in the charge of female clerks were invariably chosen for this system of depredation.

An International Telegraph Congress held at the French Foreign Office, under the presidency of M. Drouyn de Lhuys, and composed of the representatives of the different Powers. The object being no less than to unite the Old to the New World, according to a plan proposed by M. Balestrini, a member of the College of Civil Engineers, Paris.

The communication through the Malta and Alexandria cable interrupted for a brief period.

A prospectus issued by the United Kingdom Telegraph Company explanatory of the principles upon which its operations were conducted. Along the great line of the company, between London, Birmingham, Manchester, and Liverpool, messages of twenty words were transmitted at the uniform charge of 1s. A second trunk line was rapidly approaching completion, embracing the important towns of Northampton, Leicester, Nottingham, Sheffield, Barnsley, Wakefield, Leeds, Hull, Bradford, Halifax, Rochester, and Huddersfield. The company had secured upwards of 600 firms and individuals in the large telegraphing towns as subscribers, to bring the company's wires to their respective towns. The result of the company's determination to extend its lines to large towns only, as capital might be subscribed by parties interested, which constituted the company, in fact, a consumer's company. The success which attended the adoption of such a plan may be inferred from the fact that at Hull alone £4,000 was subscribed by nearly 60 of the leading merchants, brokers, &c. It appears from the report that the gross number of messages sent in this country in 1850 reached 64,734; in 1859 they had increased to 1,575,487, or 2,400 per cent. The revenue of the two old companies in 1859 amounted to £275,704, in 1860 to £297,781, in 1861 to £307,602, and in 1862 to £318,462, showing a continuously progressive increase, in spite of the depression of trade and of the much lower tariffs introduced.

In America, in 1859 upwards of 5,000,000 messages were sent, at an average charge of 1s. 4d. to 1s. 8d., producing (exclusive of press work) £400,000. In the United Kingdom the same year, 1,575,437 messages only were sent, the average charge being about 3s. 6d., and the gross receipts (inclusive of press work) £275,704.

A company formed, with a capital of £100,000, in 10,000 shares of £10 each, to establish telegraph communication at Cape Race, in connection with a light-ship.

A deputation from the Cape Race Light Signal and Telegraph Company, introduced by E. Baines, Esq., M.P., had an interview with the Right Hon. T. Milner Gibson, at the Board of Trade.

The *Levant Herald* announces that the negociation between the Porte and Her Majesty's Government, for a telegraphic service to India, had been concluded, and a convention on the subject signed.

Allotment of Shares made by the Atlantic Telegraph Company.

Information received from Calcutta that the first portion of the Persian Gulf Cable, manufactured by Messrs. Wells & Hall, and sheathed by Mr. W. Thomas Henley, had arrived safe at Gwader, on the Mekran coast of the former, and that the telegraph employés had succeeded in erecting some 280 miles of land line from Kurrachee, considered the most inhospitable and repulsive coast in Asia.

A series of three lectures delivered, at the Royal Institution, on the "Electric Telegraph," by Professor Thomson, F.R.S.

A paper on inventions relating to Submarine Telegraph Cables read, by J. Mackintosh, Esq., at the Inventors' Institute; the paper had also special reference to the testing of various compounds used for insulation, and also the testing of their impermeability.

A telegraphic message, which left San Francisco on the 2nd of June, at 9.20 p.m., brought by the "China," which sailed from New York on the morning of the 3rd, and which arrived at Queenstown on the night of the 12th, was transmitted to St. Petersburg on the 13th. The whole time occupied in transmitting the message, from San Francisco, on the Pacific, to St. Petersburg, on the Neva, being ten days and a-half, nine and a-half of which were consumed in traversing the Atlantic by the steamer.

The chairman and directors of the Channel Islands Telegraph Company have an interview at the Treasury with the Right Hon. Frederick Peel, in reference to the restoration of the line.

The Telegraph Clerks' Fund established, under the patronage of the Right Hon. the Lord Mayor, and the directors of several telegraph companies.

A paper read before the Royal Society, by Mr. C. F. Varley, on "the Relative Speed of the Electric Wire through Submarine Cables of different lengths, and a Unit of Speed for comparing Electric Cables by bisecting the Electric Wire."

An interruption occurs in the operations of the Malta and Alexandrian Cable, the fault believed to be near the shore end.

Bonelli's Telegraph Bill read a third time and passed.

A meeting of gentlemen interested in the progress of submarine telegraphy held at the offices of James M'Connell, Esq., C.E., 2, Dean's-yard, Westminster, to consider the system of Submarine Telegraphy proposed by Capt. Selwyn, R.N.; the following resolution was unanimously carried:—"That, in the opinion of this meeting, Captain Selwyn's invention is deserving of trial." And on the motion of Mr. Henry Danby Seymour, M.P., seconded by Lord Richard Grosvenor, it was unanimously carried:—"That a committee be appointed to consider the best means of carrying out the above resolution, and to open a subscription list, and that such a committee consist of the following gentlemen, with power to add to their number:—His Grace the Duke of Sutherland; the Right Hon the Earl of Shrewsbury and Talbot; Lord Richard Grosvenor, M.P., F.R.G.S.; Admiral Sir E. Belcher, C.B.; Mr. H. Danby Seymour, M.P.; Thomas Allan, Esq., C.E.; Cornelius Varley, Esq.; and James McConnell, Esq., C.E."

The Return of the Total Expense of laying the Telegraph Cable between Malta and Alexandria, published by order of the House Commons, specifying, separately, the cost of the cable, the expense of laying it, and all other items of expense; of the number of messages, and the gross receipts from all sources; and copy of the contract with Messrs. Glass, Elliott, & Co., or any other persons, for the working of the line.

The nature and extent of the injury to the Malta and Alexandria Cable explained before the House of Commons, in reply to a question from Mr. Crawford, M.P.

The directors of the Atlantic Telegraph Company advertise for tenders for the manufacture and laying of their cable.

The Mediterranean Extension Telegraph Company (Limited) announce that the improvement in their revenue had been such as to render it unnecessary for the company to apply to Her Majesty's Government for assistance, under the guarantee, and that the company's cables were in excellent working order. The usual dividend was recommended to be paid, and a sum of £544 18s. 2d. to be added to the reserve fund.

The London District Telegraph Company, although not in a position to "deal with profits," the directors expressed their confidence in the undertaking, and, comparing the present state of things with the past, they had reasons to anticipate a more cheering future. In 1860 their loss was stated at £2,168; in June, 1861, £2,177; in December, 1861, £1,995; in June, 1862, £1,077; in December, 1862, £894; and on that occasion to June, 1863, only £440.

The directors of the Electric and International Telegraph Company were enabled to report to the proprietors that the condition of the undertaking was satisfactory; 784 miles of line and 2,666 miles of wire had been added to the company's system, and that the revenue of the company from all sources amounted to £117,210 4s. 8d., exceeding that of the preceding six months by £14,843 4s. 8d. The surplus of profit on the six months amount to £39,061 17s. 5d., and a dividend of £3 10s. per cent. for the half-year was recommended. The amount of mileage as follows:—

Miles of line	8,006
Miles of wire	36,921
Number of instruments	4,163

The United Kingdom Telegraph Company held their third annual meeting of shareholders at their office in Gresham House. The report states:—"The directors having gone carefully into the accounts are of opinion that, on the operations of the last year, a balance was earned of £2,699 19s. 5d.; but seeing the incompleteness of the company's system, and the work still to be accomplished, it was thought more prudent to place that sum to the credit of construction than to declare so small a dividend as this amount would have enabled the company to pay." The report showed that the anticipations of the company as to the increase in the number of shareholders, in consequence of the company's determination to extend their wires to all those towns affording guaranteed support, had been fully realized: thus, in Glasgow there were 133 subscribers; in Newcastle-on-Tyne, 42; Edinburgh and Leith, 69; in Hull, 53; and so on of other places; whilst the total number amounted to 734.

A deputation from the Atlantic Telegraph Company waited upon the Duke of Somerset to request that the Board of Admiralty would grant the use of a vessel for making a more complete survey and soundings of the bed of the ocean near the coasts of Ireland and Newfoundland, and would also give the use of the Government ships for the conveyance and laying of the cable across the Atlantic.

A table, supplied to manufacturers, &c., by the Atlantic Telegraph Company, showing the "operation of the electrical laws affecting the speed of working through long submarine cables, exemplified in the weight of insulation in proportion to copper, required to attain given rates of transmission per minute," ascertained by Cromwell F. Varley, Esq., and Professor Thomson, F.R.S.

Information received that the injury in the Malta and Alexandria cable had been repaired, and that the cable was again open to the public.

The Marian Moore transport vessel leaves the Thames with 170 miles of the Persian Gulf cable on board.

A violent storm passes over the metropolis, causing considerable inconvenience and loss to the various telegraph companies.

Experiments made with the Bonelli Company's telegraphic apparatus between Liverpool and Manchester, which were reported as eminently successful. Every message being transmitted with remarkable accuracy at the rate of over 400 words per minute.

The Atlantic Telegraph Company announce that the capital necessary for the carrying out of this important project in the best manner had been provided, and that tenders and specimens from eight contractors had been received, in reply to the company's advertisement. These were all submitted to the scientific committee appointed by the directors, and consisting of Captain Galton, R.E., Professor Wheatstone, Professor Thomson, Mr. W. Fairbarn, and Mr. Joseph Whitworth. This committee sent in their report, unanimously recommending the board to accept the tender of Messrs. Glass, Elliott, & Co. The company had, therefore, accepted Messrs. Glass's tender, and entered into a contract with the firm, whereby the latter were bound to manufacture a cable of the best description to be approved of by the scientific committee and the Board. They also undertook to lay the cable across the Atlantic in 1864.

The Telegraph to India Company report that they had received the first half-yearly payment of £1,260 from Messrs. Glass, Elliott, & Co., under the arrangement for working the Alexandria and Suez line. And the directors recommended that a dividend of 5 per cent. per annum be paid to the shareholders, free of income-tax, for the half-year ending June 30, 1863, leaving a balance of £115. It was also stated that the company had received the concession of the El Arish line, and that a new company had been registered under the title of the Syrian Telegraph Company to carry out the same, should it be deemed advisable to do so.

Bonelli's Telegraph Company open their wires for public business (18th September) between Liverpool and Manchester.

The British and Magnetic Telegraph Company successfully lay a submarine cable across the Bristol Channel at New Passage, Messrs. Glass, Elliott, & Co. being the manufacturers and the engineers, under whose superintendence the cable was laid.

Successful experiments made with Bonelli's Typo-Telegraph, between Paris and Boulogne, a distance of nearly 170 miles.

The last freight ships, with a portion of the Persian Gulf cable on board, leaves the Thames for Bombay.

Information received that Colonel Stewart, Sir Charles Bright, Captain Stewart, Mr. J. C. Laws, and Mr. F. C. Webb had arrived at Malta, in the steam-ship, "Valetta," from Marseilles, and had passed on in the same vessel to Alexandria, for the purpose of superintending the laying of the electric cable in the Persian Gulf. The ships forming the squadron for conveying the cable to its destination will rendezvous at Bombay, whence they will proceed to lay their respective sections. The submergence of the cable is to commence as soon as possible. The staff of electricians, telegraphists, &c., have been sent in the various cable-ships, all of which have left England, and the early ones must now be at or near Bombay. The submarine line will be laid in four sections, between Bussorah, at the head of the Persian Gulf, and Kurrachee, having intermediate stations at Bushire, Khasah, and Gwader. The land line from Bussorah to Bagdad, and thence through Asia Minor, is being proceeded with with all possible dispatch. The line is expected to be in full operation about the month of July, 1864.

Two additional cables ordered by the Ordnance Select Committee of the War Department. One, which is some miles in length, is exactly similar to the first cable supplied for that purpose some two years since, and consists of a No. 16 copper, insulated with three or four coatings of india-rubber, and the only protection it has is a serving of hemp, which is afterwards tarred. Notwithstanding the apparently fragile construction of these cables, it is satisfactory to know that they are most durable. The one first brought into use in the gunnery experiments by Captain Noble and staff is, if anything, in more superior condition now than it was when first purchased; its insulation remains perfect. We dwell upon this point with much pleasure, because it will have a greater tendency to establish confidence in the effectiveness of cables, as now manufactured, than whole volumes of barren assertions, and heaps of controversy, and it is of far more value than experiments made upon a small scale by the partizans of this or that method. We may just observe, by the way, that india-rubber insulation has made great progress during the year; a greater number of miles having been manufactured than the whole that had hitherto been made since insulation first became a necessity of telegraphic extension. The other cable is of more complicated structure, consisting of four separately insulated stream conductors, thrown up with longitudinal lines of marlin, and the whole very neatly braided over with hemp, by a new process, and afterwards tarred. The extremities of this cable are divided into two parts, each consisting of two separate conductors, braided over and strengthened in precisely the same way as the main body of the cable; this bisection of the ends is required for convenience in attaching to the electro-ballistic apparatus, and the targets, &c.

A cable is thus produced of immense strength, and yet so light as to be handled, payed out, and moved about with comparative ease and facility.

It will, doubtless, be of great service in the new marine experiments about to be instituted in Shoeburyness. It is intended, of course, to be partly under water while in use—indeed the whole of it, excepting the bisected extremities; and it would be difficult to conceive of a cable more suitable for the purpose, and will tend not a little to impress the beholder that this is a method of construction eminently adapted for deep sea purposes, as combining the three great requisites, *strength*, *lightness*, and *durability*. The insulation is of india-rubber, and the manufacturers, Messrs. Wells & Hall, who have supplied the whole of the cables for the Shoeburyness and other experiments of the Ordnance Select Committee.

The application of electricity by means of telegraph cables, and the beautiful instrument of Major Narves, in recording the results of the important experiments now in progress at Shoeburyness, is worthy of being recorded in this general review of the telegraphic events of 1863. The science of warfare, both for attack and defence, would seem to be entering on a new phase, and, seeing that, with the exception of our own favoured land, the whole world is—one part deluged with blood, and the other maintaining vast armies on a war footing, and slumbering, as it were,

in a volcano, it is surely some satisfaction to know that, while we sincerely hope for the best and are fain to exercise the demon of war, we are yet determined to keep pace with the advance of science, and secure its assistance, to keep us fully prepared for the worst.

On the whole, therefore, we may congratulate our readers on the advance that has been made during the past year. Nothing very striking has occurred, it is true; nevertheless, our progress, although slow, has been sure, and moreover, has been of that satisfactory character which affords abundant ground for congratulation and renewed exertion.

THE ORAN AND CARTHAGENA SUBMARINE CABLE.

The French telegraph screw steamer, *Le Dix Decembre*, which had been lying for some time opposite the factory of Messrs. Siemens, Halske, & Co., the well known telegraph contractors, left the Thames on the 16th ult. for its destination, having on board 130 knots of submarine cable, destined to connect the Spanish town, Carthagena, with Oran in the north west of France. Considerable amount of interest is felt amongst telegraphic engineers and others with respect to this renewed effort to lay a deep sea cable, and more especially as the cable is of an entirely novel construction, and the means adopted for paying out the cable are dissimilar to those hitherto adopted. The cable is wound upon a cylinder built within the vessel, and which will be caused to revolve, in the paying out of the cable, by steam power, which also regulates the speed of the vessel. The greatest depth at which the cable will be laid is 2,600 fathoms.

The outer covering consists of a double layer of hemp strings of the strongest material, saturated in Stockholm tar, laid on spirally, and under considerable tension, the twists of the two layers running in opposite directions.

It is then finally covered by a flexible copper or brass sheathing, composed of bands of sheet copper or brass, put on spirally under the influence of great pressure, and with each succeeding turn overlapping the preceding. The covering thus produced resembles the scales of a fish, affording perfect protection without wanting in pliability.

The phosphuretted copper or brass applied for the purpose will not corrode in sea water, but remain in perfect condition for a great number of years.

The tensile strength and low specific gravity of the cable, and the impossibility of the metal sheathing uncoiling, or kinking, will remove all difficulties and risks connected with the laying of iron-covered cables of the description hitherto exclusively adopted, and also will be the means of enabling the cable to be lifted in very great depths, and after the expiration of many years.

The lightness of these cables make them well adapted for many over-ground purposes where electric wires are required—easy to be handled and transported, and of considerable strength—as for military lines, electric target wires, leading wires for mines, &c. They may with safety be laid on common ground, as even the crossing of carriages will not injure their insulation. They may be made in sizes not exceeding three-sixteenths of an inch in diameter, and at moderate prices, not exceeding those of similar iron-covered cables.

LAW INTELLIGENCE.

Scottish Vulcanite Company, Limited, *v.* Benda.—The plaintiffs in this action were assignees of a patent, dated 4th March, 1851, No. 13,542, granted to Alfred Vincent Newton, for "Improvements in the preparation of materials for the production of a composition, or compositions, applicable to the manufacture of buttons, knife and razor handles, inkstands, door knobs, and other articles where hardness, strength, and durability are required." This patent was really taken out for Charles Goodyear, the American discoverer of vulcanizing rubber, and the subject was the substance called, in America, "hard gum," and in England, "hard rubber," "vulcanite," or "ebonite," which is produced by continuing the process of vulcanizing, to its utmost extent. This "hard rubber" can be made by both the processes used for making soft vulcanized rubber, *i.e.*, by either placing the pieces of pure rubber in a bath of melted sulphur, and leaving them there until the vulcanization has taken place, or by blending the sulphur and rubber in a masticator, or by rolling, and vulcanizing the compound by steam, hot water, or hot air. The plaintiff's patent was for the latter process only, and the preparations of rubber and sulphur directed to be used, were not less than four ounces, nor more than one pound of sulphur to one pound of rubber. As their specification originally stood, the introduction of French chalk, resins, gum shellac, and other pigments into the compound was directed, but this part of the specification was abandoned, by a disclaimer allowed at the commencement of this year, by which, also, the preparation of rubber and sulphur were considerably altered. The patent also included the manufacture of hard gutta-percha by the same process. The plaintiffs had, for some time, threatened many of the English and Scotch manufacturers of hard rubber. This action, however, was the only one ever commended by them, and was brought, not against a manufacturer, but against Messrs. Benda Brothers, of Newgate-street, commission agents, for selling combs of hard rubber, consigned to them from Hamburg. Numerous objections to the plaintiffs' patent, involving questions of law, as well as of fact, were raised by the pleadings. The principal and the only one which it was eventually necessary to decide being, that both hard rubber and hard gutta-percha were, at the date of the plaintiffs' patent, well known; the former having been discovered by Mr. Thomas Hancock (of the firm of Messrs. Charles Macintosh & Co., Manchester), at the same time as he discovered the process of making soft vulcanized rubber, and included in his patent of that process, dated 21st November, 1843, No. 9,952, and the latter by Mr. Charles Hancock, and included in his patent of 12th January, 1846, No. 11,032. Another patent, taken out by Mr. T. Hancock on the 18th March, 1846, No. 11,135, was relied upon as directing the application of hard rubber for many of the purposes mentioned in the title of the plaintiffs' specification. The issues of fact in the cause came on for trial at Guildhall, before Chief-Justice Erle, and a special jury, on Tuesday, the 8th December, and the two following days, Mr. Bovill, Q.C., Mr. Hindemarsh, Q.C., Mr. Aston, and Mr. Ledgard, appeared for the plaintiffs; Mr. Grove, Q.C., Mr. Webster, and Mr. Garth, for the defendants. In support of their case the plaintiffs tried to prove, by the evidence of Dr. Miller, and other scientific witnesses, that the preparation of rubber and sulphur, mentioned by T. Hancock, and of gutta percha and sulphur, mentioned by Charles Hancock, would not make hard rubber and hard gutta-percha, the proportion of sulphur being too little; also that the sulphur bath process was a total failure, and had been long since disused. They also called several witnesses to prove that hard rubber was not known until the plaintiffs' patent, and Dr. Lankester to prove that he was a juror at the Exhibition of 1851 of the Indiarubber manufacture, and recollected no specimen of hard rubber there except at Charles Goodyear's stall. The defendants were not able to call Messrs. Thomas or Charles Hancock, their health preventing their appearance in court; but to prove that Charles Hancock's mode of making hard gutta-percha was good, they called his son, Mr. Walter Hancock, who had made all the experiments necessary to enable his father to prepare his specification, and subsequently made many articles of hard gutta-percha, some of which he produced in court. To prove that hard rubber could be and was made under Thomas Hancock's 1843 patent, they called Mr. Woodcock, the manager of Charles Macintosh & Co.'s manufactory for the last thirty years. He proved that articles of hard rubber had been made by them, and exhibited in the show-rooms of their Manchester and London warehouses prior to 1850, and that a large number were in the Exhibition of 1851, some of which he produced. He also proved that the sulphur bath was used for making hard rubber, and was for many articles the best mode, and that hard rubber could be made with a much less proportion of sulphur than that prescribed by the plaintiffs' specification. Mr. Hindmarsh was stopped in his cross-examination of this witness by Chief Justice Erle, who suggested that unless the plaintiffs had some evidence to contradict these two witnesses, it was useless going on. The jury here stated that they were all agreed that the defendants had made out their case. After a consultation among the plaintiffs' counsel, Mr. Bovill stated that they were not prepared with evidence to upset that given on behalf of the defendants, and that the plaintiff elected to be nonsuited. Mr. Grove then asked the judge for the certificate that the defendants had supported their notice of objection, which was granted, the Chief Justice remarking that the nonsuit was really a verdict for the defendants.

Rooper *v.* the Electric and International Telegraph Company.—Telegraphic Messages and the Public.—This was an action to recover 24s., money alleged to be charged in excess as porterage or despatch money upon a telegraphic message.—Mr. Haynes appeared for the plaintiff, and Mr. Cohen was counsel for the company.—Mr. Haynes said that this was a most important public question, and one that required consideration, although the amount appeared small. The plaintiff is a solicitor in Lincoln's-inn-fields, and some time ago he was stopping at Pwllheli, in Wales. A telegraphic message was forwarded to that place from London, 4s. being paid for the message, and 6s. porterage. The nearest station to Pwllheli is Carnarvon, and a horse messenger took the message, but on his road he heard that the plaintiff had gone to Llanberis. The messenger followed, and ultimately delivered the message to Mr. Rooper at Llanberis. He was charged 24s. more porterage, and paid it, and this sum he now sought to get back.—His Honour: So far as you have gone there is no case.—Mr. Haynes: I rest my case on two grounds; the first is, that the contract was to deliver the message at Pwllheli, and the second that it should have been sent by a public conveyance, which would have conveyed it much more cheaply.—Mr. Cohen urged that the company was entitled to deliver the message to the person to whom it was addressed. This message was ad-

dressed to Mr. Rooper, and he had accepted it and paid the charge made. He could not now set up a claim for the money so parted with.—His Honour: I am quite of opinion that there is no case. The plaintiff might have refused to receive the message at Llanberis, but he adopted another course, and he could not now deviate from his own motion. He had paid the money and accepted the message, and must be bound by his own act.—Mr. Haynes: The contract is to deliver the message at Pwllheli, and surely your honour would not throw such immense power into the hands of the company as to say that they are entitled to follow plaintiff to Scotland.—His Honour: If there had been £10,000 involved, perhaps Mr. Rooper would have been greatly delighted to have obtained the message even then, but we are now dealing with this case.—Mr. Cohen: We are clearly entitled to follow the plaintiff, and he cannot now recover back the money. Our contract is to deliver the message to Mr. Rooper, and he has had it. Our charges are 1s. per mile, and that sum has been paid by plaintiff.—His Honour: I am of opinion that the plaintiff cannot recover. He might have refused to accept the message at Llanberis, but he did not do so, and, on the other hand, accepted it at the last place. The company make a stated charge, and the plaintiff paid it for the message.—Mr. Haynes then said, even if the judge were against him on this point, there was clearly an overcharge on the porterage.—Mr. Cohen objected, that the plaintiff had paid the porterage for the message, and he could not now set up an overcharge.—His Honour: The company are entitled to charge 1s. per mile, and if they have charged too much they must refund.—Plaintiff said that the landlady at the inn at Llanberis brought up the message, and plaintiff paid 14s. The landlady came up again, and said there was 10s. more to pay, and plaintiff paid it.—Mr. Cohen put in the receipt for 14s., and called attention to a printed notice on the receipt that the receiver of the message should not pay any more than the sum marked on the form.—His Honour said that plaintiff ought to have read the printed words on the form, and as there was a doubt as to the mileage, he would nonsuit the plaintiff.—Plaintiff nonsuited.

CORRESPONDENCE.

THE JURORS' REPORT ON CLASS XIII.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I shall be glad to know if you intend re-publishing in the pages of the *Telegraphic Journal* "The Jurors' Report of Class XIII. of the International Exhibition of 1862." I think it would be most advisable to do so. It may appear to some that a pamphlet some three or four months old, which has gone forth to the world unquestioned in any of its parts, is too stale and uninteresting an affair for resuscitation. To ordinary and superficial readers such a demurrer would certainly be unanswerable. But there are certain points concerning it which will suggest themselves to the thoughtful observer in a very different light, and which may be esteemed equally unanswerable on the opposite side. We must not forget that, in the Exhibition of 1851 telegraphy and electrical science through their instruments, manufactures, and mechanical adaptations were virtually unrepresented; and it is also notorious that in the Exhibition of 1862 this important department of mechanical science was all but ignored in comparison with other sciences of infinitely less moment. Mixed up as it was with a conglomeration of "Philosophical Instruments and Processes Depending on their Use," it suffered in every conceivable way. The mere sight-seer, after having left the building, had certainly no distinct idea which were philosophical and which electrical instruments that had passed under his rapid survey. Nor were more intelligent observers a vast deal wiser. But if it suffered in this way from want of that distinct prominence which was its due, it necessarily suffered tenfold more so in the appointment of jurors to report upon the class. The distinctive characteristic of Class XIII. had been all along philosophical. Except in the catalogues there was nothing to indicate that there was such a thing in the whole vast area of the building as specimens of telegraph wires, galvanometers, or any description of electrical and telegraphic apparatus. It followed, therefore, as a matter of course, that when the jurors were chosen, *three only and one expert* knew anything at all about the most important part of the contents of the class on which they had to adjudicate. The burst of disappointment and indignation which found vent when this became known is fresh in the memory of all. True, the few electrical jurors who were chosen were eminent in their profession, save that they have never failed to evince certain prejudices, and were biassed to an extent quite sufficient to incapacitate them for the impartial duties they had to perform. But even had this not been the case, the fact of their being, almost without an exception, either exhibitors in *propria personæ* or by proxy, utterly disqualified them for an appointment which they ought never to have accepted. In the matter of awards, therefore, everything turned out just as it was expected. Many were disappointed, and yet they were not disappointed when they came to reflect calmly on the whole affair. The truth is, the excellency of their productions were not appreciated, and how could it be otherwise?

The getting up of the report on electrical instruments, &c., devolved, as it would appear, mainly on the gentleman associated with the jurors of that class—Mr. Fleeming Jenkin. Hence it was a long time making its appearance—so much so, indeed, that many persons had began to forget the Exhibition which had given it birth. The report is none the less important on that account; and doubtless it will be considered that, on the whole, Mr. Jenkin has acquitted himself very creditably. The bulk of the readers of the *Telegraphic Journal*, however, have not, and will not have, an opportunity of judging for themselves on this matter, unless it is presented to them in your pages. I confess I should much like to see it there, and freely commented upon from week to week. By this means certain points would be brought under discussion which require to be thoroughly sifted. Mr. Jenkin no doubt is entitled to a great deal of credit, and his views and opinions, as therein recorded, are entitled to considerable deference; but there are many important points dwelt upon by him to which not a few will demur; it is highly desirable, therefore, that these should be thoroughly sifted. Besides, it must not be lost sight of that a juror's report of the International Exhibition is a weighty document, and is, therefore, treated as an authority superceding all others. It becomes doubly important, therefore, that all doubtful points should be cleared up; and where our author is at issue with facts, and experimental data are set at nought, it is the least we can do to protest against it; for opinions, even from a professor's chair, if they are at variance with known facts, should not go forth to the world without a corrective.

Brompton. JAMES SPICER.

[We had a portion of the report in print for our first number, but it was crowded out.—ED. T. J.]

TELEGRAPHY AND HER MAJESTY'S GOVERNMENT.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I cannot agree with your correspondent of last week—E. F. G.—in the matter of Government assistance to submarine telegraph projects. I, in common with most Englishmen, look with a jealous and suspicious eye on the dabblings of the Government in matters which may be safely left to the capital and enterprise of public companies to accomplish.

Hitherto, as becomes a constitution like ours—which we may proudly assert is the envy of the civilised world—the executive have carefully avoided meddling with projects which have the remotest appearance of entrenching upon what we may be allowed to term the peculiar prerogative of the British subject; and, whenever they have unwisely evinced a tendency to deviate from so desirable a course, the attempt has always been met with a burst of general dissatisfaction, which has invariably lapsed into an organised opposition before which the recalcitrant has invariably given way, and abandoned an assumed, untenable, and dangerous position. Without gliding imperceptibly into a political diatribe, I may be allowed to remark that, to this disposition of jealous watchfulness and prompt action we owe not a little of that constitutional freedom of which we are so justly proud.

Our Government has always abandoned with a good grace every essay of the sort on the slightest symptom of popular mistrust, and hence a great many people think they overstrain the matter, and err on the opposite side; if it be so, it is certainly an error on the safe side, at which no man should grumble. We have no cause to fear that our highly-favoured land will ever lapse into, or emulate, continental or even transatlantic despotism; still, we should be careful not to encourage any course of action that would give the slightest pretext for copying in any single thing the bad example of such blind guides. The lines of railways and telegraphs in the hands of the Government, and under their sole control, is an uncomfortable state of things for the Briton who, from necessity or choice, has taken up his abode in a land where such a state of things exists, and we may be sure he makes as little use as possible of the latter for very obvious reasons.

I deplore the depressed condition of submarine telegraph enterprise as much as your correspondent, but every ball will rebound in proportion to the force with which it has been hurled. The whole history of the world is but one long homily on the text that one extreme of necessity produces, or is succeeded by, its opposite—periods of intense excitement followed by flacidity and languor. Even personally, metaphorically, or otherwise, if a man kill the fatted calf this week, the chances are that he will have only the bones to pick next.

The presumptuous self-confidence manifested in our first essays on submarine telegraph projects, and the utter disregard of the commonest precautions, led to failure, and necessarily produced distrust among those who had been its most enthusiastic supporters. And, as over-sanguine people shiver under a wet sheet far more than moderately-tempered persons, the result is that the shivering fit is not over, and, therefore, another paroxysm of enthusiasm can hardly be expected until they become convalescent; but assuredly we do not require Government nerve and equanimity to supply the deficiency.

I deeply regret the Atlantic telegraph should languish for want of sustenance; it is no credit to the nation certainly that the funds are so long dribbling in for the proposed cable. But who are to blame? Your correspondent would throw the onus on the Government because they decline to give substantial assistance. This is not fair. The Atlantic Company have only themselves to blame; but doubtless, if they evince their worthiness of support, it will not be long in forthcoming from other quarters than Downing-street.

I rejoice in the prospect of our being put in daily communication with the teeming millions of the Orient; but I must say I would rather have had

the Persian Gulf telegraph the property of a company than of the Government. It seems somewhat strange that the India Board should be in advance of the times; usually the reverse is the case. Apparently the gigantic failures of submarine lines has laid private enterprise prostrate. This is a pity. Suppose railway projects had remained dormant in the same way, and Government had come to the rescue and constructed a few lines of its own, would that have been flattering to us as an enterprising people, of indomitable will and energy, not to be frightened at trifles? Submarine telegraphy languishes—granted. But it will come all right in time; wait for it, and do not seek to do that which you might live to regret.

H. I. J.

RE-EXAMINATION OF CANDIDATES BY INDIAN BOARD OF TELEGRAPHY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Please state, through the medium of your paper, if it is imperative a candidate should not exceed the age of twenty-four, or if he is rendered ineligible if exceeding that age by a few months. Yours, &c.,

Glasgow, Jan. 6, 1864. D. K.

[Our correspondent had better write to the "Under-Secretary of State for India, India Office, London, S.W."—ED. T. J.]

TELEGRAPHIC NEWS.

THE vessel with the Otrant and Avelona cable on board, left the factory of Mr. W. T. Henley, at North Woolwich, on the 7th inst.

WE are glad to hear that Dr. Sutro, of 37A, Finsbury-square, has become honorary physician to the Provident Clerks' Fund, and that several new members have joined the fund during the last week.

BY the demise of Mr. John Watkins Brett a vacancy occurs in the direction of each of the following companies—viz., the Atlantic Telegraph Company, the Submarine Telegraph Company, and the Mediterranean Extension Telegraph Company.

THE Submarine Telegraph Company have given notice, that in consequence of the French Administration having determined to increase their rates to Spain and Portugal, the price of transmission of messages between England and those countries is necessarily increased.

BY an agreement entered into betwen M. le Vicomte de Vongy, Director General of Telegraphic Lines, and M. A. Callaud, of Nantes, and approved by the Minister of the Interior, the battery without a porous cell, invented by M. Callaud, is adopted for the telegraphy of the State. The system has been employed on the Orleans Railway Telegraph for the last five years.

A telegram received by the Electric and International Telegraph Company on the 6th inst., announces that the telegraphic station at Iakoutsk, on the route to China, was opened on the 2nd December; the distance from St. Petersburg being 5,700 verst. It is believed that messages which formerly took 23 days by post, will now reach that point in eight hours.

LETTERS have been received from Sir Charles Bright, Lieut.-Col. Stewart, Mr. J. C. Laws, and Mr F. C. Webb, announcing their safe arrival at Alexandria, and also of their departure to Aden, and from thence for Bombay, all well. The vessel *Assaye*, with a portion of the Persian Gulf cable on board, was spoken to near Cape of Good Hope, reported all well.

MR. L. W. COURTENAY, whose retirement from the secretaryship of the Submarine Telegraph Company we announced in our last number, has been succeeded in the important office by S. M. Clare, Esq., a gentleman who had been for some time employed under the company.

THE London District Telegraph Company are now constructing a private telegraph for the Speaker of the House of Commons, from his official residence, in Palace-yard, to the new stables, which have just been completed, in Millbank-street, Westminster.

THE authorities at the British Museum have requested Captain Shaw, of the London Fire Engine Establishment, to have a telegraph provided from the Museum to the Fire Brigade Station in Holborn. The London District Telegraph Company have just completed the communication.

THE Peruvian Government has determined to construct a network of telegraphy over the whole of its territory, consisting of 430,000 square miles, or four times the extent of that of Great Britain and Ireland. The population of Peru now exceeds 1,500,000. Several proposals have been received from eminent contractors to carry out the proposed system.

CAPTAIN SPRATT, R.N., retires into private life, after an honourable and useful career of thirty-two years, employed in the survey of the Levant and Mediterranean. His name will be honourably remembered in connexion with the assistance and counsel he was enabled to give, from his extensive hydrographical experience in those waters, in the several operations of submerging electric cables, some of which exist to this day as monuments of successful scientific undertakings.

THE Director-General of the Imperial Telegraphic Lines has been for some time engaged in negotiations with various Governments for reduction in the prices of telegraphic messages sent to foreign countries. He has succeeded in reducing the price of telegrams to Spain from 9fr. to 2fr. from the 1st of the present month. The telegrams to Switzerland, which at present pay 9fr., will be sent for 3fr. Thus commercial and private relations between France and foreign countries are becoming day by day less difficult.

THE Kingdom of Greece has 12 telegraph stations, all the messages between the Greek and European lines pass through Turkey, and consequently the rate is very high. There would then be a considerable interest in establishing a direct line between Greece and Southern Italy. It is known that there exists already a submarine cable from Otrante to Corfu, another is required from Corfu to Panras or Missolonghi, across the Ionian Islands. The depth of water would be small.

ON the 3rd inst., Captain Tyler, R.E., the Government Inspector of Railways, made his final inspection of the Charing Cross Railway. Among the gentlemen present were—Mr. Hawkshaw, the engineer; Mr. Wythes, the contractor; Mr. Eborall, the general manager; Mr. Knight, the traffic superintendent; Mr. Walker, the telegraphic superintendent of the South Eastern Railway; Mr. Cockburn, Mr. Saxby, and other officials. The examination commenced at the London-bridge extremity of the line, where Captain Tyler minutely inspected the working of the signals, both semaphore and telegraphic. At the junction of the main with the short line or arm, which is to connect the former with the future Cannon-street City terminus, the inspector entered the signal-box and rigidly examined the working of Mr. C. V. Walker, F.R.S.', admirable system of train signalling, which was considered satisfactory in every respect.

THE PORTLAND AND QUEBEC TELEGRAPH.—As may be seen from the following notice, taken from the Maine newspapers, a telegraph line is about to be constructed between Portland and Quebec:—The undersigned will petition the next Legislature as follows: "To the Honourable the Legislature of Maine.—The undersigned respectfully petition for an act to incorporate the Maine and Provincial Telegraph Company for constructing a line of telegraph from the city of Portland, by the most eligible route, to Quebec and other points in the British provinces, with the usual privileges of like corporations in this State.—J. J. Speed, Gorham, Me.; J. W. Lane, Portland, do.; S. C. Hay, Brooklyn, N.Y.; Theodore Adams, Philadelphia, Pa.; T. H. Wilson, Harrisburg, Pa.; Henry Morgan, Aurora, N.Y.; Nathan Randall, Homer, N.Y."

THE telegraph in Russia is making rapid progress. From a recent report published, it appears that on the 1st of January, 1862, there were no less than 19,530 versts of telegraph lines, and a total length of wire of no less than 32,330 versts. On these lines there were 169 stations, with 1,920 *employés* of all grades; 415 instruments, and 6,750 elements of Daniell's battery. During the course of the year the number of messages transmitted reached 627,000, of which 559,000 were paid for, or rated. The receipts of the telegraphic administration were 1,176,761 roubles: the receipts for inland messages being 1,048,020 roubles, and for foreign messages 128,742 roubles, besides 52,456 roubles which were received to the profit of the postal service, and 198,828 roubles for the foreign telegraphic lines. In comparing the preceding figures we obtain an excess of receipts of 156,146, representing about 4 per cent. per annum of the capital of 3,536,900 rubles, applied up to the 1st of January, 1862, to the organization of the telegraphic service.

IN the Turkish territories there are now twenty-eight telegraphic stations, of which twelve are open for night service (Adrianople, Chios, Elbassan, Gallipoli, Nissa, Routschouch, Salonica, Scutari, Smyrna, and Toultcha), nine during the whole of the day, and seven for a part thereof. One station, that of Ouzoundjowa, only works during the fair, which takes place yearly, from the 15th of September to the 8th of October. La Canée possessed a telegraphic station for some time. Since the interruption of communication between Candia and Chios the despatches are posted at Syra. Constantinople has two stations open for international correspondence—one at Stamboul, the other at Pera; the first is principally confined to the transmission of messages for the Ottoman Government, and the second for that of ambassadors and private persons. In the case of an interruption of the cable which crosses the Hellespont, the Dardanelles station is removed to Kalid-Bahas, and the despatches are subjected to an additional rate of 4fr. 50c. for their conveyance by boat from Kalid-Bahar to the Dardanelles. The tax upon messages between Paris and any Turkish station varies from 14fr. 50c. to 30fr., according to distance.

A TRANS-PACIFIC TELEGRAPH.—In the Message of the President of the United States to Congress the following passage appears:—"Satisfactory arrangements have been made with the Emperor of Russia, which it is believed will result in effecting a continuous line of telegraph through that Empire and the Pacific Coast." The President also recommends to the favourable consideration of Congress "The subject of an international telegraph across the Atlantic Ocean." Furthermore, the news by the *Etna* informs us that the report of the Hudson's Bay Company recommends the construction of a telegraph from Canada to British Columbia, and states that the requisite negotiations are in progress with the Home Government, as well as with the Governments of the two colonies." We have no means of knowing how far the preliminary proceedings have gone in any of these cases, and must forbear speculating until the papers bearing on the subject are published, which they must shortly be. The President announces definitely that arrangements "have been made with the Emperor of Russia" for a trans-Pacific telegraph, while he merely recommends the trans-Atlantic project to favourable consideration. It would appear from this that the former project is in a greater stage of forwardness than the latter; but it by no means follows that it will be completed sooner. Mr. Cyrus Field and his co-workers are making earnest efforts to secure the construction of the International Telegraph, and a large amount of stock has already been sub-

scribed. Glass, Elliott, & Co. offer most advantageous terms, and little besides the aid of the British and American Governments required to be secured to insure a start being made. The prospect of a trans-Pacific telegraph being commenced in earnest will probably give an impetus to this scheme, which will enable the yet remaining difficulties to be surmounted and induce immediate action. England cannot afford to allow the United States and Russia, by means of an overland line, to monopolise the advantages which would be drawn from the telegraphic union of the two continents. But whatever it may be, Canada is on the right side; if we cannot get communication with Europe *viâ* the Atlantic, we shall *viâ* the Pacific. The Hudson's Bay line will connect us with the latter, which must pass through British territory—a point Mr. Lincoln, in speaking solely of negotiations with Russia, appears to have overlooked. No telegraph, whether it comes from the continent to the eastward or the westward, can reach the United States unless Britain gives her consent. To an American citizen, Mr. Perry Collins, belongs the honour of having originated the proposition of a trans-Pacific telegraph. Years ago he travelled the immense distance from St. Petersburg to the mouth of the Amoor, and thence northward to the Behring's Straits, for the purpose of ascertaining whether the construction of a telegraphic line were possible. Mainly by his exertions the Russian Government was roused to the importance of the matter, and, that once done, they commenced the work and have prosecuted it with vigour. By the middle of next year it is anticipated that the wires will have reached their settlement at the mouth of the Amoor. They will thus be in possession of the longest telegraphic line in the whole world. To connect San Francisco with the Amoor, various routes are proposed. The coast line, it is agreed on all hands, must be followed northward from San Francisco, through Washington territory and the British possessions, into Russian America. It then remains to be considered whether the narrow Behring's Straits shall be crossed or whether a sea route further south shall be followed. The latter appears to be the favourite. If any of our readers will take a good chart they will see that in latitude 55 deg., longitude 160 deg. west, the Russian promontory of Aliaska, or Alyaska, extends in a south-westerly direction for many miles. Stretching all the way from the extremity of this promontory to Kamschatka, on the Asiatic side, are the Alutian Islands, which may readily be connected by means of short cables. The wires then might be taken round the coast of the sea of Okhotsk to the Amoor. The whole distance from Washington to London by this route would be upwards of 19,000 miles. Along more than 12,000 miles of this distance the telegraph will be stretched before the end of next year.

MISCELLANEA.

IT is estimated that 25,000 persons are engaged in Peru in obtaining india-rubber to supply the foreign demand.

IT is on record that the *Morning Chronicle* was the first daily English journal that availed itself of the application of the electric telegraph to report speeches and proceedings; the result of a railway meeting on a week evening in the Isle of Wight, being reported through the instrumentality of the telegraph on the South Western Railway, between Southampton and Nine Elms, a distance of 72 miles, and appearing in the paper the next morning.

WHEN Franklin made his discovery of lightning and electricity it was sneered at, and people asked, "Of what use is it?" To which his apt reply was, "What is the use of a child?—It may become a man!" When Galvoni discovered that a frog's leg twitched when placed in contact with different metals, it could scarcely have been imagined that so apparently insignificant a fact could have led to important results. Yet therein lay the germ of the electric telegraph, which binds the intelligence of continents together, and probably, before many years elapse, will "place a girdle round the globe."

IT is curious to stand in the instrument-room among 80 young ladies busily at work, and watch the different idiosyncrasies as developed in the manner in which each conducts her operations. One dashes at her instrument with an impetuous rapidity that soon brings to utter grief the "washers" which confine the noise of her "plungers" within some sort of bounds, and for whose replacement she is mulcted of some portion of her weekly pay. Another raps on slowly and steadily as part of the day's work to be done. Here a pair of bright black eyes, glistening from under a forehead from off which the hair has been pushed with a quick impatient gesture, are glittering impatiently as the little hand raps a sharp rebuke to a stupid correspondent in some distant part of the town or country. There a pair of sentimental blue eyes turns gladly from the completed message to the novel whose more exciting scene has been interrupted by an inquiry after the missing keys of some unromantic Smith or Brown. This girl is smiling or frowning over her work in evident appreciation of the message under manipulation; that plods steadily on her way, and would telegraph to the Tower the signature of her own death warrant, were such documents accustomed to pass that way, without the slightest idea that anything of particular importance had been passing through her hands.

EBONITE.—The venerable Thomas Hancock, in his *Personal Narrative of the Origin and Progress of the Caoutchouc or Indiarubber Manufacture in England*, states, "I remember at that time (1820), when exhibiting a piece of my solid rubber to an old gentleman, he examined it, and, returning it, made this remark, which bids fair to be realized, 'The child is yet unborn who will see the end of that.'"

PRICES CURRENT OF INSULATING MATERIALS.

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities.	2/3 to 2/6 per lb.
Good re-boiled	1/7 to 1/10 „

INDIA RUBBER.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/1 to 1/2 „
Java and Penang	1/4 to 1/6 „

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph	100	106 to 109	—
100	Submarine Telegraph, scrip.	all	45 to 55	—
all	Do. registered	all	3/8 to 5/8	—
5	United Kingdom Telegraph	3	¾*d* to ½*d*.	—
10	Mediterranean Extension Tel.	all	2½ to 3½	—
5	London District Telegraph Co.	all	1½ to 2	—

TO CORRESPONDENTS.

Erratum.—Page 7, second column, third line, instead of "Bailey," read "Varley."

Lessons in Electricity and Telegraphic Manipulation will shortly appear.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of all news-agents in town or country, and at the various railway stations; or, it can be supplied, if preferred, direct from the Office on the following terms (paid in advance):—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)	0	3	0

Single Advertisements from the country must be accompanied with stamps in payment.

THE TELEGRAPHIC JOURNAL.

VOL. I. No. 3.—JANUARY 16, 1864.

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SUBMARINE TELEGRAPHY AS AN ENTERPRISE.

IN our last number we endeavoured to show that Submarine Telegraphy is an enterprise which might be engaged in with perfect safety, from the fact that the manufacturer of cables, as well as the facilities for paying out at sea, have arrived at that state of efficiency, as to render success certain, and failure the trifling exception, oracularly held to prove all rules. It cannot well be otherwise, indeed, if the manufacturer is a skilful and practical man, the electrician honest, and all who have to do with subsequent operations are experienced in the work.

There was one point omitted, however, which, by some, may be esteemed of no trifling importance. That there is a great diversity of opinion as to the best form of cables for long deep sea telegraphs, and that, until this matter has been set at rest by practical means, in other words, by the proof which only a submerged cable will afford after having been in work a considerable time, the whole subject will necessarily engender doubt as to the prospects of success, of which we are so confident.

We are not disposed to treat this objection lightly, nevertheless we believe it to be the prolific parent of needless nervousness. The idea of heavy cables for such a purpose, if ever entertained, has been long since abandoned. All agree that a light cable, is not only sufficient, but the best, providing it have a specific gravity that will admit of its gradual descent to the bottom in a reasonable time. In fact, it is *strength*, not weight, that is required. It is simply, therefore, *the best form of light cable*, to which this apparently formidable difficulty is reduced, a problem, so easy of solution, as hardly to deserve the name of one.

There are many styles of light cables invented and patented, any one of which would be admirably suited to the purpose. Doubtless each has peculiar merits of its own, and, perhaps some of them, in the long run, would prove superior to the others; but they are all, more or less excellent, and, if any one of them were tried, we have no hesitation in saying that they would far exceed the expectations formed of them. We make this statement without the slightest reservation, save that the maker should be bound by contract to supply the whole equal in every respect to specimen; but this is presumed in all cases.

There are three main points to be studied in the choice of a light cable, to which we may briefly advert, premising that, if the one selected in any case should embody, in the greatest degree, these essential qualities, it will turn out to be the very best form of cable that can be made.

First.—It should be light, with a maximum of strength.

Secondly.—It should be of such a nature as to be proof against decay (comparatively), and the attacks of marine animalcules, should any exist at those great depths.

Thirdly.—The outer covering should be so applied as to ensure the greatest possible flexibility, without risk of elongation or kinks.

There are several light cables, that we know of, which fulfil these conditions; and, if there should remain doubt on the point of durability, it is easily set at rest by coating the whole with a specific compound, which, while it adds to its strength, is an effective preventive against the inroads of decay, and the whole tribe of gourmands, fabulous or otherwise.

We wish to give all possible force to this part of our subject, in order to restore that confidence in submarine telegraphic enterprise which should exist; not that we would foster a vain-confidence, or lead any person astray in so important a matter. We promulgate our views, and put forth our conclusions, because we have the best and most satisfactory grounds for them; for there is no one point on which we are more thoroughly satisfied, than that which the foregoing is intended to demonstrate.

In passing on to notice, briefly, the highly remunerative character of submarine telegraph lines, we feel that we have entered upon a work well nigh superogatory, since this is a necessary result of the first part. Very few will have any misgivings on this head, if they are satisfied upon the other. Happily, the most distrustful begin to see that failure, although it has been the rule, rather than the exception, is not a necessary consequence of such ventures. It is, however, a difficult task to enforce the conviction that the whole state of these matters will be inverted. It is far from easy to impress a man against his conviction, especially if such conviction has been produced by means which never fail to leave an indelible mark behind. An individual who has once lost, rarely has his faith resuscitated in similar projects, although it may be clearly demonstrated that he was a sharer in misfortune, by virtue of immatured experience, and all the evils which that, and overweening self-confidence entails.

We take our position, therefore, on the assumption of having proved the practicability of submarine telegraphy being an enterprise which, if due precaution be exercised, is no more liable to mishaps than other projects which absorb the attention of mankind, and, we are bold to say, has not more than an ordinary share in the chapter of accidents.

In order to show the advantages it offers to the mere capitalist it is not necessary to apply *couleur de rose*, and make it appear that a good cable will never wear out; that there will be no failures, no accidents, and so forth. We will take the matter upon reasonable grounds, and allow for wear and tear, for accidents, and all the train of ills to which things human are subject. Reckon that a new cable would be required every twelve years, as a rule, no matter what the locality, and it could easily be shown that, in even so limited a period, the receipts would far more than counterbalance the outlay, enable the company to pay a dividend rarely met with in these times, besides securing a reserve fund, for repairs, or resuscitation.

The history of the few submarine cables yet in existence, afford ample proof of this; and this is all the more remarkable when we consider that these lines were constructed at an enormous, and what, in a few years, will probably be deemed an incredible cost.

Making every allowance for the advanced cost of insulating, and other materials, which a demand for submarine cables will produce, it may, nevertheless, be safely calculated that future deep sea cables will cost, on the whole, considerably less than any cables yet submerged. This is easily understood, when we consider the defective method hitherto adopted for the various processes, and the vast expenses incurred in many ways, which we now see were wholly unnecessary. Add to this, moreover, that a good cable, securely deposited on the bed of the ocean, would be far more durable than we have taken credit for, seeing that both gutta-percha and india-rubber are improved by

submersion and pressure; and, assuredly, we are warranted in concluding that there is no enterprise of the present day that offers so large a return for the capital invested.

It is scarcely safe to indulge in the reflections of what might have been, had the Atlantic cable proved a success, and it had turned out capable of a moderate amount of work. Certain it is that the company would have been the wealthiest, and most powerful of the day. And it may be, even yet; nay, it is certain to be. No project of the time offers such vast advantages as that which connects two hemispheres, the commercial relations of which are to be valued at millions sterling annually.

THE INTERNATIONAL EXHIBITION, 1862.

(*Continued from p.* 19.)

3. *Instruments employed in the Transmission of Messages.*

These instruments have undergone many important changes. The needle, or galvanometer instruments spoken of with great approval in 1851, are still extensively employed in this country; but the Morse dot and dash instrument has been very largely adopted, and on the Continent is used almost to the exclusion of all other forms. At this moment, the old form of embossing Morse receiver is giving way before an ink-writer, printing the same code.

The acoustic telegraph, in which the signals are received by ear, first devised by Steinheil, and long neglected, is now in favour, and is used in India, America, and Great Britain. Relays have come generally into use, both to complete local circuits at receiving stations, and for the mechanical retransmission of messages from one section of the line to another. Many beautiful examples of these instruments are shown, and their use has been followed by a great extension in the capabilities of the telegraphic system.

To a limited extent various forms of dial step-by-step instruments are in use, and many excellent examples are shown, all more or less modifications and improvements of those exhibited in 1851. On the other hand, many instruments then thought worthy of reward have disappeared, without coming into practical use; and especially it may be remarked that none of the type-printing instruments then exhibited have been permanently adopted. Fresh ingenious forms are shown to effect the same object; may they be more fortunate than their predecessors!

Automatic transmitting instruments of great merit are exhibited; by their use increased speed, regularity, and distinctness may be obtained, and it is hoped that their adoption may allow messages to be sent at very low prices, and that, consequently, the use of the telegraph may be greatly extended. It is to be feared that this object will not be fully accomplished until the public prepare in some form their own messages for transmission, so as to reduce the functions of the company to a minimum. Now, the companies may be said to write each message twice over unnecessarily—once at the sending station with the transmitting key (and this would not be altered by the proposed use of punched paper or type transmitting-sticks), and once again after the message has been received. M. Bonelli's system, the lineal descendant of Bakewell's, alone of the automatic plans, dispenses with this second transcription; but M. Bonelli's plan cannot yet be pronounced practically successful. It is to be feared that, so long as this large amount of work is thrown on the companies' hands, the time saved by transmitting 400 or 500 letters per minute, instead of 100, will not justify any very great reduction of tariff, especially as the increase of speed must be accompanied by some loss of facility for interruption and interrogation. The success of the penny postage is frequently appealed to in favour of a low uniform rate, but the supposed analogy between the postal service and the telegraph is far from complete. In the one case the cost of transport hardly increases at all with the bulk transported; in the other case, after certain limits are passed, the cost of transmission increases almost in direct proportion to the number of messages sent. These limits depend on the number of messages per diem, which fully occupy the clerks and wires, and differ widely, no doubt, according to the system adopted. As improvements are gradually introduced the tariff will gradually be lowered, and the most sanguine anticipations may be realised; but no great sudden change could, in the writer's opinion, be effected even by the most ingenious apparatus exhibited.

Electric railway signals are shown, some of which are good practical instruments, and others are ingenious contrivances. The importance of this application of the electric telegraph to the protection of life can hardly be over-estimated; but it is probable that the simplest and most direct plans are the most to be depended on.

Messrs. Siemens & Halske, of Berlin, show the system adopted in many German towns for giving alarm in case of fire; and M. P. D. Prud'homme, of Paris, exhibits the domestic signals and bells now used in the Louvre Hotel, and other large establishments in France.

4. *Philosophical Instruments.*

The most important *philosophical instruments* connected with electricity are those by which the various measurements of electrical quantities are effected. These are four in number, each requiring its separate unit of comparison:—

1. Strength of currents;
2. Quantity of electricity;
3. Electro-motive force, or difference of potential, sometimes called tension;
4. Resistance of conductors.

The measurement of resistance has perhaps hitherto attracted more attention than that of the other electrical quantities; and resistance coils, based on different arbitrary units, are sent by exhibitors from France, Switzerland, Germany, and Italy, as well as by English makers. No two of those sent even from the same country are alike; a state of things attended with much the same inconvenience to electricians as would be felt by engineers, if every man chose the length of his own foot rule. Except those founded on the so-called absolute measure, none of the units have been chosen with any reference to the other electrical quantities, and still less with any regard to the units of force and work.

This is not a fit occasion to give a full account of the beautiful and coherent system of Weber and Thomson for the expression of these quantities in absolute units, chosen with reference to their relations with each other, and with the units of force and work which must henceforth be looked on as the connecting link between all physical measurements; but the leading idea of the system may be briefly expressed as follows:—

A battery, or other rheometer of unit electro-motive force, will generate a current of unit strength in a circuit of unit resistance, and in the unit of time will convey a unit quantity of electricity through this circuit, doing in the same time a unit of work or its equivalent. These relations leave the absolute magnitude of the series of standards undetermined. Weber has proposed to fix the series in various ways; but the most convenient (where measurements have to be made by observations conducted with the aid of magnets) is probably that in which the series is fixed by the definition of the unit current, as that current, the unit length of which at a unit distance exerts a unit force on the unit magnetic pole. The definition of the unit magnetic pole, proposed by Gauss and Weber, in its turn depends solely on the units of mass, time, and length. This admirable system, which cannot fail of ultimate adoption, is not yet so generally known as to have produced many instruments intended specially for its illustration or practical application.

Nevertheless, apparatus are exhibited which would, with more or less accuracy, enable every one of the required measurements to be made. Thus, tangent galvanometers are shown by various makers, and the absolute strength of current in the above units may be obtained from any one of them by the following formula:—

$$y = \frac{R^2 H}{L} \tan D,$$

where y = strength of current in electro-magnetic units,
D = deflection observed,
R = radius of the coil,
H = horizontal component of the earth's magnetism,
L = length of the wire composing the deflecting coil.

The quantity of electricity contained in any statical charge might be deduced with the aid of the make-and-break apparatus, or "Wippe" exhibited by Messrs. Siemens & Halske, by which a succession of charges are sent so rapidly through a galvanometer as to give rise to a constant deflection; from this deflection the strength of current may be calculated as above, and the quotient of the strength by the number of discharges per second will give the statical charge in the above measure.

Professor Thomson's electrometer gives direct measurements of potential or electro-motive force in arbitrary units, which can by a simple coefficient be reduced to the above absolute measure. The electro-motive force of a battery would be still more simply ob-

tained by multiplying together the absolute strength of current produced by it in a given circuit, and the absolute resistance of that circuit. The resistance coils exhibited by Mr. White, of Glasgow, were intended to represent decimal multiples of these absolute resistances, and these coils can be used for comparison, like any others, without reference to the principles which led to their original determination. These examples are given to show that the use of the above series of standards entails no special difficulty in the observations, and does not even require that the principles on which they are based should be understood by the observer.

The value to electrical science of a coherent system such as we have mentioned is very great; when generally adopted the results of independent observers all over the world will become comparable, and vague expressions of opinion will be replaced by definite measurements. Messrs. Siemens, Halske, & Co. exhibit an excellent arrangement for the comparison of resistances: their apparatus is based on Professor Wheatstone's bridge, or electric balance, as it might, perhaps, be better named.* No resistance coils were exhibited in 1851, although Professor Wheatstone's rheostat and resistance coils had been described in the "Philosophical Transactions" as early as 1843.

Two novel forms of galvanometer are exhibited—first, Professor W. Thomson's marine galvanometer, by which accurate observations of all kinds can be made at sea in all weathers; secondly, Gaugain's conical tangent galvanometer, by which he expects to secure a more perfect proportionality between the strength of the currents tested and the tangents of the angles observed.

Under the head of philosophical instruments may be included chronoscopes, of which it is to be regretted that none are shown by English makers. Professor Wheatstone published a description of the first instrument of this kind in 1840, and subsequently these instruments have received great attention from inventors in all parts of Europe. They have hitherto been chiefly applied to the measurement of the velocity of projectiles, a measurement effected by determining the time elapsing between the rupture of two wires placed in the path of the ball. Some idea of the perfection to which these instruments have been brought may be formed from the claim advanced both by M. Hardy and by Professor Gloesener, that by their instruments accurate results can be obtained at any part of the trajectory when the wires are only a yard or two apart. Improvement is, however, still possible in the methods used to obtain the perfectly uniform or constant motion required in the apparatus. Several forms of chronograph are shown for registering the instant at which an astronomical or other observation is made. The instrument exhibited by M. Krille, of Altona, appears to the writer especially meritorious.

Next may be mentioned the instruments used for the automatic regulation of the carbon electrodes of *electric lamps*. No less than eight distinct contrivances are shown for this purpose. Some more suitable for optical experiments, some for signals, and some for lighthouses, or similar practical applications. Faults might still be found with each instrument, but it is impossible to watch the quiet, steady flame of Mr. Holmes' light, or to see Mr. Serrin's lamp extinguished and relighted at a distance twenty times a minute by the simple interruption and re-establishment of the electric current, without feeling that on future occasions electric lamps will be classed rather among the practical applications of electricity than among philosophical instruments.

Induction coils of great merit are shown, by which currents of extraordinary intensity are developed in secondary coils of no extravagant length. These apparatus have acquired fresh interest from Mr. Gassiot's valuable researches. Tubes for showing the discharge in vacuo, and in various highly rarefied gases under a great variety of conditions, are exhibited by Mr. Ladd; many of these are made, however, in Germany. An electric resistance thermometer, a registering thermometer, and a current regulator, are novelties of considerable merit, and will be described in detail.

The great impulse given to the study of dynamic electricity by its application to the electric telegraph has somewhat diverted attention from statical phenomena. Mr. Varley, however, exhibits an interesting instrument for the production of statical charges of high tension and considerable quantity without friction or chemical action. This is effected by the direct transformation of mechanical energy into electrical effects by the intervention of induction alone. Fine samples of electrical machines with discs of vulcanite or hardened india-rubber are exhibited.

The want of a good meteorological electrometer, complained of in 1851, is remedied by Professor Thomson's portable instrument exhibited by Mr. White, of Glasgow. No improvements in permanent magnets or electro-magnets (unconnected with telegraphic apparatus) are shown, nor any novel apparatus connected with thermo-electricity. The University of Pavia contributes a collection of instruments now well known to all, but most interesting as having originally belonged to Volta.

(*To be continued.*)

* This is called by Professor Wheatstone the differentia resistance measurer.

BONELLI'S TYPO-ELECTRIC TELEGRAPH.

A very interesting meeting was held on Monday night at the offices recently taken by the Bonelli Company in Angel-court, Throgmorton-street. The object of the gathering was to witness the working, and discuss the merits, of the Chevalier Bonelli's beautiful system of telegraphic communication. The results must have been highly satisfactory to those interested, for it would be difficult to imagine anything more conclusive than the experiments, or more unanimous than the verdict given alike by amateur and professional spectators.

The instruments put into communication were two of the six originally constructed, one pair of which are at work between Manchester and Liverpool, the remaining pair being at Paris, where they are about to be placed—one at the Bourse, the other at the Great Central offices in the Rue de Grenelle.

The question of working with equal facility at a distance having been definitively put at rest by the experiments which have taken place between Paris and Boulogne, the proceedings of the evening assumed a position of importance and reliability wholly removed from the category of chamber experiments, and we are bound to say that the introduction of these instruments upon main lines promises to effect a complete revolution in telegraphic communication, such at least appeared to be the universal impression.

Throughout the evening the instruments were kept constantly at work, and without hitch, failure, or defect of any kind, the messages were transmitted and received with a rapidity truly wonderful.

The carriages were set to run their course in twelve seconds, and in this space of time a message was a thousand times over received and transmitted at and from each station; as the type boxes contain about thirty words each, it follows that these instruments are capable of printing with apparently unerring precision at the astounding rate of 18,000 words per hour; this, as the promoters consider it to be *slow* rate, is involved by the necessity of using for commercial work a solution which gives, under the action of the electricity, permanent marks. In transmitting press or other work, which has to be within a few hours set up in type or transcribed, the company propose to use the iodide of potassium; the decomposition of this salt is so facile, that the instruments would be able to print, in characters even more legible than those produced through the medium of the manganese, at the rate of 72,000 words per hour.

All the parts of the instruments appear simple and strong, and a very careful examination failed to detect anything which would convey the idea of delicacy or liability to derangement. The combs used were old in the service, and, we were assured, were rather better than worse for the work done. It is easy to understand that, with such a system, the proposed reduction of the price of each message of twenty words to sixpence may be found compatible with the interests of the shareholders, while it would be difficult to conceive that, even with such a reduction, any business can arise which would overtax the transmitting power of the machines.

We are thus promised the inestimable boon of cheap telegraphy eliminated from the too frequent drawbacks of delay and incorrectness.

Among the gentlemen present, whose numbers were doubtless, much diminished by the unfortunate locality and the inconvenient hour selected, were the following:—Lord Otho Fitzgerald, Dr. Smee, P. Le Neve Foster, Esq., Secretary of the Society of Arts; C. Le Neve Foster, Esq., F. N. Gisborne, Esq., W. Hall, Esq., W. Y. Dent, Esq., E. O. Brown, Esq., W. T. Henley, Esq., Frederick Purdy, Esq., R. Wills, Esq., J. L. Wheeler, Esq., Irving S. Taylor, Esq., F. Smith, Esq., Owen Rowland, Esq., W. D. Starling, Esq., James Figgins, jun., Esq., J. Spiller, Esq., Henry Cook, Esq., F. Faithful, Esq., B. H. Tindall, Esq., &c.

We are informed that it is intended to hold another meeting, and that any gentleman making a written application to Mr. Cook will be shown the instruments in operation.

TO ERECT A LINE OF TELEGRAPH.

(*Continued from p.* 17.)

THE following will be found a very useful form of survey:—

JANUARY, 1864.

Survey of proposed Line of Telegraph from Dipping to Cumberland Corner, being 18 miles per the Dipping railway, and thence by high road 10 miles, from Alloway Hill to Cumberland Corner. To consist of overground poles, carrying three English oak arms, respectively 22×2×2 inches, 20×2×2 inches, and 18×2×2 inches; compressed porcelain insulators, two single shed and four double shed, and the wire to be B.B. galvanized W.I., No. 8 B.w.g.; porcelain shackles, known as Bright's patent; binding wire, No. 16, &c., &c. The poles to be of good seasoned larch, with sound butts, not less than nine inches diameter, tapering to five inches diameter at the top.

Date of Survey.	No. of Stake or Mark.	Distance in yards.	Poles.			Arms.			Insulators.		Shackles.	Bolts, 6×½×½.	Wire.		Solder.	G. P. Wire.	Wood troughs.	REMARKS.
			18	24	30	18	20	22	Single	Doub.			8 Cwt.	16 lbs.	lb.	yards.	feet.	
1864. Jan. 4.	1					1	1	1			6	3	9	1	1	360	60	Start from Dipping Station:—1 *Standard*, 36×3×3½, English oak, to be fitted to booking office wall, with 2 *W.I. bolts*, 18×1×1. Leading, in boxing, to have 20 *clamps to order*. (Mem.—The wire allows for lightning conductors of No. 8 wire.)
	2	70		1		1	1	1	2	4		3						
	3	70			1	1	1	1	2	4		3						
	4	70			1	1	1	1	2	4		3						
	5	65			1	1	1	1	2	4		3						
	6	70			1	1	1	1	2	4		3						
	7	68	Cor	ner	1	2	2	2			12	6						Cross to opposite side of line over goods yard, straight.
	8	50	Cor	ner	1	2	2	2			12	6			1			
	9	70			1	1	1	1	2	4		3						1 *pitchpine Standard*, to be fixed to side of engine shed, 96×4×6, with 2 W.I. bolts, 18×1×1, and lead to order.
	10	70				1	1	1	2	4		3						
	11	70			1	1	1	1	2	4		3						Repair roof.
	12	70			1	1	1	1	2	4		3	9					On mound of cinders rising from level.
	13	68	1			1	1	1	2	4		3						Direction of line—
									&c.	&c.	&c.							
Jan. 7.	451	100	Cor	ner	1	1	1	1			6	3	9	1	1	720	300	Reach Cumberland Corner, and pass underground to Alloway Hill, 100 yards. 1 *cwt. Stockholm tar, and 50 lbs. pitch*, to order.
	452	60				1	1	1	2	4		3						
						&c.		&c.		&c.								
Total Length																		1 *Standard, English oak*, 36×3×3½, *with* 2 *finials*, to be fixed to wall of Mr. Briggs' house.

The following will be found a very near approach to an estimate for such a line:—

	£	s.	d.
79 poles, 18 feet long, each, 5s.	£19	15	0
50 " 24 " " 7s.	17	10	0
550 " 30 " " 10s.	275	0	0
25 standards, pitchpine, each 96×4×6, 5s.	6	5	0
25 wall pieces, English oak, each 36×3×3½, 6½d.	0	13	6½
679 earthenware polecaps, 4d. each	11	6	4
75 finials, 6d. each	1	17	6
739 arms, English oak, 18×2×2; ditto, 20×2×2; ditto, 22×2×2; say 2,217 arms, at 3d. each, planed and bored to order	27	14	3
2217 W.I. bolts, 6×½×½, as per pattern; say 15½ gross, at 12s.	9	6	0
1446 single shed porcelain insulators, with W.I. pins and nuts, 6d. each	36	3	0
2892 double ditto ditto 1s. each	144	12	0
96 porcelain shackles, 1s. 6d. each	7	4	0
26 tons No. 8 B.B. galvanized iron wire, at £19 10s.	507	0	0
40 lbs. No. 16 galvanized iron wire, at 3d.	0	10	0
20 lbs. best solder, at 9d.	0	15	0
2 miles No. 16 copper wire, covered with No. 8 gutta-percha, at £24	48	0	0
420 feet wood boxing, 2×2, with 1-inch groove, and lids, at 3d.	5	5	0
Sundry iron work, including extra sized bolts	2	0	0
Pitch and tar	1	12	0
Repair of roofs, including lead	2	0	0
Stripping, dressing, and charring 679 poles; each to have a red ring drawn round it, six feet from the butt, at 1s. each	33	19	0
Carriage of goods, carting, and laying out stores	9	0	0
Labour:—1 Foreman, 12s. per diem; 2 carpenters, 6s. do.; 3 linemen, 6s. do.; 12 labourers, 3s. 6d. do.; 3 boys, 2s. do. 21 men, earning, jointly, £4 10s. per day, for 28 days	126	0	0
Painting, *by contract*, 729 poles and standards; poles to be tarred; two good coats of tar 12 inches under the surface, and four feet above the ground; the rest to have two good coats of stone paint. The standards to have two good coats of stone paint. 2s. each	72	18	0
Railway fares, and travelling expenses	4	10	0
Sundries	2	0	0
Supervision	68	12	6
	£1,441	8	1

Thus it will be seen, by this estimate, that a line of six wires, erected in the most substantial manner, and finished in such a way as to stand for twelve or fifteen years, and including the supervision of a professional telegraph engineer, may be provided at a cost of about £51 10s. per mile. No doubt men could be found who would undertake the work for a less sum, but it is very questionable if a perfect working line, such as a telegraph line should be, can be erected cheaper. One item, that of tools, is omitted. Every carpenter finds his own tools, every labourer his own pick and spade, and, as the tools required by a telegraph lineman are not expensive, and his wages are calculated at the same rate as a carpenter's, it is considered as an equivalent, and that it is time the trade of a telegraph lineman should be regarded as a distinct calling, and thus render it unnecessary for telegraph companies to invest any part of their capital in tools and kits. Of course it is equally desirable that the lineman's wages should be calculated on the same principle as that of the carpenter, stonemason, or any other trained workman.

For the maintenance of such a line, the cost is easily calculated. It is erected with a view to lasting fifteen years. Divide, therefore, the total sum, and it will be found that the annual cost of the line will be less than £2 per mile. For the first five years there should be no charge whatever upon it, save for one course of tarring and painting, an item that figures in the estimate for £72 18s.

It is necessary to recommend that the larch trees for poles should be felled in the winter, the sap is then out of the wood, and the timber harder, and more durable. It will take a little longer to dress the pole, but that is allowed for in the charge. Take care that the pole is turned out as smooth as it can be, and that no knots or swellings are allowed to remain.

The object of the red ring, which we believe was first adopted by Sir Charles Bright, is simply to save trouble in examining the poles when set in the ground, as it is then easy to see that each has been placed a sufficient depth. The stores having been sent forward, and paid out according to the survey, a copy of which should be given to the foreman, the gang may go to work.

The men to dig out the holes go first, three pairs (men always work best in couples), and one lineman takes the six men, as also the two carpenters, who fit the arms, insulators, polecaps, and lightning conductors, erect the standards, and render any help that may be required in rearing the poles. Avoid fixing poles to

the bridges of railways, they are better in the earth, and more likely to stand severe weather. If attached to brickwork, and they rock at all, they will be sure to bring a parapet down, and the consequences to the company you represent may be serious. This gang of nine men may have one boy, and the lad will soon prove that, in his way, he saves a man's wages.

It is a good plan to fix the poles for a month before the wiring begins, but, with careful men, any fear of unsteady work is avoided, and we will therefore suppose that, as the poles are set, the wiring gang prepares to follow; this gang includes the two linemen, six labourers, and two boys. The jointing of the wire should never be left to a labourer; it is a lineman's duty, and by far the most important one. In running six wires, the lineman will want the help of a labourer, for the purpose of holding the wires to be jointed, while the boys take the firepots, &c.; but it is the lineman, and the lineman only, who must bind the joint, and apply the solder, and it is well that the foreman should keep an occasional eye to seeing that these are done with care, and not hastily. We prefer the Britannia joint to any other in use.

The wire should be pulled up by blocks; this prevents the jerking that breaks so many insulators. When it is pulled up to its full tension, it should be slightly released, and this will allow it to contract or expand, as the weather becomes colder or warmer. When fastened down to each insulator by the binding wire, the arm should be carefully examined, to see if the strain has shown any sign of weakness in the arm, insulator, or bolt, and if so now is the time to apply the remedy.

Should any strain lead the foreman to consider it requisite that a guard should be placed over the wire, he will order it to be done. It is a matter for consideration if it be not advisable to place a guard over every insulator, and, certainly, for work along high-roads, or round railway curves, it is only a proper precaution. They can be procured for about 3d. each. In this manner the line will soon be completed. The terminations of the wires should then be placed to air, and each one carefully tested. If a wet day can be taken advantage of, all the better, and the slightest loss should be sought out by the foreman. As soon as the line is reported in writing, by the foreman, to be electrically perfect, the engineer will inspect the works, and test the wires, and then, if handed over to the party for whom it is erected, under the written certificate of the engineer himself, there can be no difficulty in placing the responsibility on the shoulders of the proper party.

It is not unlikely that we shall meet with some unfavourable comments upon our advice on this subject. Our calculations may be wanting, or they may be too high. We can only repeat, that a good line is the cheapest in the end, and that the telegraph companies, at the present time, fully recognise the necessity of exercising the greatest care in the construction of their works. Every insulator should be tested before it is erected, and if found, however slightly, in fault, it should be rejected, for that fault will increase, and give rise to many intermittent faults, if allowed to go on the work. But the insulator will form the subject of another paper; meantime Mr. R. S. Culley's work is one, that if for this section (insulation) only, should be in the hands of every telegraph engineer.

ON TIME AND TIME-GUNS.

THE Report of the Astronomer-Royal for Scotland, lately read before the Board of Visitors of the Calton Hill Observatory, calls attention to a subject of great and growing interest which, for some reason or another, is rather strangely overlooked by us Southrons. We allude to the question of correct time-keeping. It, indeed, is more than strange that in this London of ours especially—where, above all other places in the world, time is money—the true time is scarcely to be had.

It has been well said that we can arrest the flow of time by continued motion, and, by journeying faster than light, actually travel into the past again. The London clocks, however, lessen the difficulty of this feat, for the time once gone—the old proverb notwithstanding—oft returns, and is repeated by lying tongues from a hundred steeples, in spite of the warning tone of Big Ben, which, on the Astronomer-Royal's authority, we can point out as a brilliant exception; albeit one arrived at by much labour, seeing that an attendant receives a signal from Greenwich once *every hour*, and the clock reports its state to Greenwich twice every day.

The eminent men in charge of our national observatories are as ready and willing to "lay on" time to our towns as they are to our coasts. Thanks to their labours, the noble problem of finding the longitude at sea has now been solved with a perfection which leaves nothing to be desired. It is possible now to calculate the place of the moon for years to come with a precision which shall surpass that with which a single instrumental observation can be made of it. So that, in fact, unless we improve our time-keeping on shore, the mariners will be ahead of us.

We have before alluded to the magnificent conception which is now being carried out in Paris. So far back as 1852 M. Paul Garnier suggested the establishment of a normal clock, electrically connected with others, which the current should drive and regulate. At the present moment M. Verité, who has reduced the question of electrical regulation to one of great simplicity, is applying it to all Paris. A transit instrument is to be erected in the Tour St. Jacques, where meridional observations will be made and the normal clock installed. Four dials on this noble tower, *furnished with seconds-hands,* will show the time, which electrical currents will give to seventeen other principal clocks, similarly furnished—these in their turn regulating all the other public clocks of Paris. So much for correct time-keeping *à la Française.* In our account of the British Association we described the method adopted in Scotland, and many who have not yet crossed the Tweed had occular and audible demonstration of it at the meeting at Newcastle, when at one o'clock the true time was proclaimed by cannon from the commanding top of the fine old Border Castle, in its turn o'ertopped by the world-renowned "High Level."

Professor Smyth, in his report, tells of the extension now being given to this eminently practical system. Since the Newcastle meeting, when it was in operation both there and at Shields, and was fully appreciated both by seamen and landsmen, Sunderland has applied, and has now its permanent time-gun. Several other cities have followed suit, and the local negotiations for the means of loading their respective guns are in different states of forwardness, the only one which has at present succeeded in perfecting its arrangements being Glasgow, the Queen of the West. Professor Smyth writes:—

"The Edinburgh Observatory dropped a model time-ball daily for a week by electric means in a public meeting-room of the Glasgow College in the year 1855. That work was successfully performed, besides its principle having been formally approved; but somehow there was not enough in the time-ball system itself to fully interest the practical inhabitants of the great western city. When, however, after eight years had elapsed, and the inventions of Professor Wheatstone had enabled an electric current to explode a distant gun more easily as well as certainly than to drop a ball, and the citizens of Glasgow did locally provide a cannon, and, aided materially by the well-known Magnetic Telegraph Company, did connect it by wire with the Edinburgh Observatory, and when the current from there did consequently discharge the Glasgow gun simultaneously with the several guns of Edinburgh, Newcastle, and Shields, the strong common sense of Glasgow's citizens immediately perceived the superior efficiency of the new system; for, after a week's experiment with from 2 lbs. to 2·5 lbs. of gunpowder a day, from a cannon temporarily placed, as will be seen in a schedule recently received from them, they are now vigorously adopting a new and more suitable locality, with the noble charge of 8 lbs. of powder, or nearly double of what is used at any of the other stations."

In our number for the 24th of January last we gave an extract from the *Scottish Society of Arts,* showing that the Edinburgh time-gun is actually regulating the clocks within a radius of some sixteen miles. Of what incalculable advantage must this be both to employer and employed! Why are we not as well off in London as they are in Scotland? or, indeed, in Liverpool, where, thanks to Mr. Hartnup, who prefers the Parisian system, there are many controlled clocks, and where, it would seem, there is such a superabundance of the true time, that Mr. Hartnup has volunteered time-signals to London—to our shame be it spoken! Let us, *en passant,* mention that, on the 4th of February, 1861, between six a.m. and five p.m., one thousand eight hundred and sixty persons compared their watches or chronometers with one of Mr. Hartnup's controlled clocks.

Greenwich is by no means behindhand in fostering this good work; but at present London is slow to appreciate its value. From the Royal Observatory time-signals are sent daily along the principal lines of railway, even as far as Glasgow and Cardiff, and *many private companies through whose offices the wires pa[illegible] have begun to distribute branch signals to private factories.* At the [illegible] at Aldershot, where, we believe, one of these signals is received, [illegible]

time-gun has lately been in operation, although it is fired by something less ethereal than electricity.

It is a thousand pities that the Westminster clock, which we learn on such excellent authority keeps true time, has its value so seriously impaired by the absence of a seconds-hand. It may be urged that there are many clocks in London so furnished. True, but we pity the luckless wight who shall put his faith in them. We have known many instances where a journey to Greenwich has actually been performed when time true to a second has been required; for we regret to say that the Harrison clock of the Astronomical Society, which ought to show true time, and did a little time ago, has left off doing its duty. The Astronomical Society has in this matter lost an opportunity of doing good work.

Let us conclude by expressing a hope that either Professor Smyth's or M. Verité's method may soon be introduced where certainly it is most wanted; let us not be content in this metropolis to be behind Paris, or even our own provincial towns and private factories. M. Verité's arrangement commends itself at once to all. The following extract from the last published volume of the Edinburgh *Astronomical Observations* will show us the great practical value of the former method. A combination of both of them would best suit London.

Professor Smyth, after referring to the time-gun system, remarks:—

"Thus much, then, for the *idea*, and next, on the experience of nearly twelve successive months, we can add that the *practice* of this audible signal has answered to admiration in almost every point. For instance—1st. It has never given wrong time yet, by any accidental discharge before or after the intended time, even to a fraction of a second. 2ndly. It is so remarkably prompt in its action that there is absolutely, and to the most refined observation no sensible retardation between the striking of the tick of the sixtieth second by the normal clock in the Observatory and the visible gun-fire at the Castle. This result, which is superior to that which occurs with the time-ball by about 0·14 of a second, the amount of constant retardation observed there, is produced by a peculiar compensating action in the controlled clock at the Castle, whereby the trigger of the gun is pulled at such a fraction of a second before one o'clock, that the explosion takes place exactly at one. 3rdly. No inclemency of weather, as rain, frost, or snow, or wind of any strength and from any direction, has ever interfered with the regularity of the gun-fire; and this speaks well, not only for the manner in which electricity is employed to do the work required of it between the Castle and Observatory, but also for the soldiers at the Castle told off to the duty of daily loading the gun, and often having to perform it under circumstances of such extreme wet and discomfort that, unless they exercised much care and skill the igniting quality of the powder might easily be affected. In fact, since the 7th of June last year, there is only one proved weak point in the whole arrangement; and that is, the quality of the friction fuses, which are prepared by, and furnished from, the Royal Arsenal at Woolwich; for one bad fuse—that is, one which does not go off at all, and therefore causes no gun-signal to be heard that day—is still occasionally met with amongst a large number of good ones."

Let us hope that before very long the maps of London shall contain those red concentric circles which already distinguish those of Edinburgh, Newcastle, and Glasgow.

We reprint the foregoing article from the *Reader* at the request of an esteemed correspondent.

SOCIETY OF ARTS.

Wednesday, December 10th, 1863.

DR. W. A. MILLER, F.R.S., IN THE CHAIR.

ON MAGNETO-ELECTRICITY, AND ITS APPLICATION TO LIGHT-HOUSE PURPOSES.

By F. H. HOLMES, ESQ.

As this is a paper on the application of Magneto-Electricity to lighthouses, I will begin by saying a few words on lighthouses themselves, their former and present state, and the systems now generally followed in the arrangements for lighting.

Formerly lighthouses were very few, and were nearly all coal fires on high cliffs or towers, and most of them were the property of private individuals; but, as shipping increased, so the lighthouse system became more and more developed, both in the number of lighthouses and in the improvement of those already existing. The coal fire gradually gave way to the oil lamp and candles; next we find the introduction of spherical mirrors or reflectors, and these, again, were superseded by parabolic reflectors, sometimes to the number of more than thirty in one lantern. After this came the introduction of the "Fresnel Lens," which took the place of the reflectors and their lamps, however numerous they might be, and required instead one central lamp.

This "Fresnel Lens" has again grown, so to speak, larger and larger, as the want of a more powerful light was felt, till it has now a diameter of 6 ft. and a height of 10 ft.—for to increase the quantity of light the size of the lamp must be increased, and the lens in proportion, or it would have been so far out of focus that the intention of the lens would have been frustrated.

To make these progressive improvements in lighthouses, vast sums of money had to be expended; and now let us see what was the end sought. First to improve the light itself. This is done by the substitution of a lamp of four concentric wicks, the largest nearly 4 in. in diameter, for the coal fire. If the improvement had stopped at that it would have been small indeed, but this lamp is more under command than the coal fire. The value of the introduction of oil is not so much then on account of its greater power, as for its aptitude for the employment of economising apparatus, whether this consists of reflectors or lenses. All incandescent bodies give out rays, as it were, from the centre to the circumference of a sphere; of such rays only those which fall on the sea would be useful to the mariner, but by means of reflectors those rays which would pass inland, or upwards, or downwards, are reflected towards any required point, and by a proper arrangement of a series of reflectors, the whole, or nearly the whole, of the rays are directed where required. The Fresnel Lens consists of a middle refracting belt, and a double series of reflecting prisms, or zones, as they are generally termed, and when properly constructed it has the property of collecting all the rays into one horizontal beam, so that all the light from the lamp is utilised. Thus, then, we see great strides have been made since the introduction of oil lamps, as regards the lenticular apparatus—in fact, that may be said to be nearly perfect; let us then return to the consideration of the light itself for a moment.

Whether a large or a small lamp be employed it will make no difference in misty weather, so long as the thickness of the flame is the same, for a large lamp may be equal to ten or twelve smaller ones, and if replaced by these ten smaller, it will be evident that when one of these is obscured by mist, the whole of them will be obscured. Quantity of light then will not add to its power of penetrating mist. By making the large lamp with four concentric wicks the intensity of the light is a little increased, and such a lamp will penetrate further through mist in a slight degree. But it is in misty and hazy weather that the light is most required; hence, now that everything else is nearly perfect in a lighthouse, the authorities, both in this country and elsewhere, are directing their attention to the only thing wanting to make the whole system perfect, that is a light capable of penetrating mist; and as this power depends on the intensity of the light, and electricity is capable of producing the most intense light known, it was naturally looked to as the possible means of perfecting the whole system. But the light produced by electricity to be applicable for lighthouses must be certain and constant, not liable to extinctions or any great variations, as the first would tend to endanger vessels seeking and not finding the light; and if a fixed light had much variation, it might be mistaken for a revolving light.

Let us now see whether electricity can produce a constant steady or uniform light. Frictional electricity will give a succession of flashes intensely vivid, and might be used for the purpose, but for the fact that the slightest moisture is sufficient to convey the whole charge to the earth. The various forms of galvanic battery are all capable of producing a steady and intense light, but still (besides the great expense) they are not applicable, because of the necessarily varying current, which becomes weaker and weaker as the solution becomes saturated. The magneto-electric machine is then the source from which one would naturally expect a light which should be invariable in its nature, and capable of being continuous for any given time, as the current produced by this machine is constant as long as the helices revolve with the same speed, and the speed can be easily regulated to any required velocity.

The electricity derived from a magneto machine is induced in coils of wire, by the changing of the magnetic polarity of pieces of soft iron enclosed within the coils of helices; and the quantity or intensity of the induced current depends, first, on the amount of magnetism induced in the soft iron; secondly, on the facility with which the poles of the magnetised soft iron can be reversed; thirdly, on the velocity with which the change of polarity takes place; fourthly, on the length and diameter of the wire forming the helices.

The amount of magnetism induced in the soft iron depends on the size and force of the steel magnets employed, and on the weight and softness of the iron in the helices; but the weight in practice of the soft iron is limited by the weight of the steel magnets, for, if too heavy, the steel magnets will be slowly deprived of their magnetism. To facilitate the change of the poles, the soft iron cores of the helices are not solid pieces of iron, but are tubes, single, double, or treble, as it is found by experiment that the same weight of iron, when divided in this manner, loses or takes magnetism in much less time than when in a solid form.

There is a limit to the velocity to be employed when the maximum of electricity is required, for this reason. It has been already remarked that the amount of electricity depends on the amount of magnetism taken up, and that the soft iron takes time to become saturated, as it may be termed, with magnetism; hence, if the velocity be too great with which the cores move from one pole of a magnet to another, there will not be sufficient time for the cores to become saturated. But as, again, the quantity of electricity increases as the velocity increases, it is necessary to ascertain this maximum point exactly, which is easily done, either by experiment or calculation, based on certain data. The length and diameter of the wire require to be different, according to the current required; for a short thick wire, forming the helices, represents a galvanic battery composed of a dozen, say, of very large pairs of plates, whilst a long thin wire would represent a battery composed of thousands of small plates. In other words, supposing the size of the helices to remain the same, if they are composed of thick short wires, quantity is obtained; but if composed of long thin wires, intensity will be the result.

From all this it results that there are certain laws known and established, by which a magneto-electric machine can be made to give a current of any given amount of electricity, with any given ratio between its quantity and intensity.

Having seen on what the production of the current depends, the next point to observe is the peculiar nature of this induced current. It differs essentially from a galvanic current in this, that while the helices are revolving, the direction of the current is reversed, as the core of soft iron passes each consecutive pole of the steel magnets.

It now remains to explain how the current generated in the wires of the helices is to be withdrawn from the machine. In the first place all the helices are connected in two, or four, or more series; in doing this, great care must be observed that the direction of the coil of every alternate helix is in an opposite direction, that is, if one is wound as a right-hand screw, the next should be as a left-hand screw, or, what amounts to the same thing, supposing all wound in the same direction, then the two inner ends of the wires must be joined of, say, Nos. 1 and 2, and the two outer ends of the wires of Nos. 2 and 3, and so on through the series; and lastly, the terminals of the series might be soldered into two insulated discs, and then led from the machine by two pieces of metal kept in contact with the outer surfaces of these discs by a slight spring; such an arrangement allows the alternating current to pass from the machine, and such a current will produce a light, but this light has certain disadvantages. It is never white, but always more or less blue or brownish; in fact it is like the electric light obscured by placing it behind a flame from spirits of wine. It is also extremely injurious to the eyes, both from its colour and its tremulousness; I therefore do not use this current, but in its stead I convert this constantly-inverting current into two that flow from the machine in one direction only. This is accomplished thus: one half of the helices are arranged so as to arrive on the poles of the magnet at the instant that the other half are exactly midway between the poles. Thus there are two distinct currents; and what may be called the dead point, that is, the point when the current inverts in one series occurs exactly at the time when the other current is at its maximum, so that if now the inverted currents can be again inverted in both of these distinct currents, and that the two now flowing in one direction can be united as one compound current, it is evident that the result will be a current nearly as uniform as that from a galvanic battery, with the advantage of equable continuity. This is done by the two commutators, which consist each of two insulated rings of metal, of such a form at the periphery that two rollers or rubbers change sides from one disc to the other at the same instant that the current is reversed. Then, by combining the two commutators, a compound current is obtained that will produce a constant white light, or perform any of the other functions of the galvanic current, and in a more perfect manner, as it is more uniform in its action.

A steady and constant current thus obtained from the magneto-electric machine is only one part of the problem of producing a constant and steady light, and, although the most important part, still it would be perfectly useless without an efficient lamp or regulator. In order to understand this it is necessary to explain that the carbon points used for producing the light, or for converting a portion of the electric current into light, are consumed, and that the rate of consumption is irregular, owing to the irregularities in the structure of the substance used, which is the kind of graphite deposited in the gas retorts sawed up into pencils about a quarter of an inch square; but as the consumption is irregular, no clockwork with continuous motion could be employed for the purpose of causing the carbons to approach as consumed, for it must be understood that the steadiness of the light as well as its brilliancy depend on the two carbon points being maintained constantly at a certain distance corresponding to the strength of the electric current.

Many pieces of apparatus more or less complicated have been invented from time to time, for the purpose of regulating the movements of the carbon electrodes, and many of them I have tried, but none of them, as formerly constructed, could be used in a lighthouse, because they were more or less uncertain in their action, and because the clockwork was too delicate and liable to accident in other hands than those of an electrician. The question, what constitutes a good regulator, must be answered by stating what it must accomplish; and, moreover, it must perform its several functions in the most simple manner. It must, in the first place, maintain the carbons at a given distance, whatever be the variation in the state of consumption, and must also be capable of being adjusted to any strength of current; secondly, if by any accident the current should be interrupted, and the light thereby extinguished, the regulator should be capabe of relighting at once with full brilliancy, that is, not only must it allow the carbon points to touch to re-establish the current, but must separate them again instantly, or there would be no light. Such a regulator we have here, for its construction is simple, and it performs its different functions in a most perfect manner. Its construction is this: the upper carbon is attached by a kind of small vice to a bracket, standing out from a tube, which slides freely in a column. The lower carbon is fixed in the end of another tube, exactly under the other carbon. Both of these tubes are put in motion thus: two cords, passing over pulleys, properly arranged, are wound on one spindle, but in opposite directions. On turning a stud fixed on the end of the spindle, the regulator is wound up; that is, the top bracket is raised, and the lower tube depressed. On removing the hand from the stud, the upper tube would descend, and, being loaded, would cause the lower tube to rise; but to prevent this, while the regulator is out of use a bolt is pushed in, which prevents any movement in the regulator till it is again withdrawn. The regulator being wound up, the carbons are firmly fixed in their places by tightening the holders, and are then adjusted so as to bring the points in the focal plane by turning a spindle to which the fixed end of the cord belonging to the lower carbon is attached.

So far the regulator is only a means by which the carbons can mutually approach each other with a certain relative speed, depending on the different diameters of the two parts of the spindle around which the cords are wound. But if the carbon points remain in contact, there will be no light. Some contrivance, then, was necessary to separate the points to the distance, which, by experience, is found to give most light, and to maintain that distance between the points constantly till the whole of the pair of the carbons is consumed. These two operations are accomplished thus: the fixed end of the cord which works the upper carbon is attached to one end of a lever; the other end of the lever has a piece of soft iron attached to it, over an electric magnet, so that when the bolt is withdrawn and the carbon runs together until they touch (thus allowing the current to pass) this electro-magnet instantly, by the action of the same current, lifts the cord, and with it the upper carbon, to the required distance. But this is not all, for the carbons would again run together were there not some contrivance to prevent them. To accomplish this, advantage is taken of these two facts—first, that the quantity of electricity is proportional inversely to the distance between the carbon points; secondly, that the strength of an electro-magnet is proportional to the quantity of electricity passing through the wire that surrounds it. Bearing these two facts in mind, it will be easy to understand the use of the second electro-magnet. Over this electro-magnet, at a small distance above it, is placed a lever, one end of which is drawn down by a spring, the strength of which can be regulated by a thumb-screw. The fulcrum is between this end and the centre. The

other end of the lever is furnished with a catch, and immediately over the electro-magnet a piece of soft iron is fixed in the lever. On the carbons being allowed to touch as before, not only are they separated by the means described, but this second lever, acted on by its electro-magnet at the same instant, is drawn down towards it, and thus brings the catch between the teeth of a wheel placed under it for the purpose, and effectually locks the regulator. The strength of the spring is now adjusted till its tendency to lift the catch out exactly balances the current which draws it down. Should the distance now increase but the $\frac{1}{500}$th of an inch, the spring will be stronger than the current, will lift the catch, and the carbons will approach; but by doing so more current passes, the electro-magnet is strengthened, and is again enabled to overcome the spring and draw down the catch, and thus by their mutual action the distance between the carbon points is all but invariable.

When these regulators are employed in a lighthouse there are a pair for each lens and two small lenses, so that although it may take ten minutes to replace the consumed carbons, still the light is never extinguished; for, suppose the carbons consumed in the lens No. 1, the regulator is ready in lens No. 2; and all the light-keeper has to do is to bolt the No. 1 regulator, and draw the bolt of the regulator in No. 2 lens; the current is thus diverted, No. 2. is instantly lighted, and the lighting of this extinguishes No. 1.

Thus, then, we have a most intense light, which may be maintained for any length of time, which does not require to be trimmed or extinguished for a second, and which has all the steadiness and uniformity required for lighthouse purposes. Its advantages over the oil lamp are—first, its power can be increased *ad libitum* without increasing the size of the lens, for, if required, a machine may be made to give light enough to read by, say, at ten or twenty miles; in fact, the light is in direct proportion to the power of the machine that produces it: secondly, its great intensity gives it a power of penetrating haze only equalled by the sun: thirdly, its whiteness distinguishes it most perfectly from all other lights on shore, which is one of its most important properties, for many a vessel has been lost for want of this property in lighthouses lighted with oil: fourthly, where coloured lights are required, for the purpose of distinguishing one lighthouse from another, this light gives all the colours in a perfect manner, while the oil lamp always gives its own tinge to the colour employed: fifthly, from the facility with which this light can be extinguished in an instant, and as instantly lighted to its full power, it offers other means of distinguishing lighthouse from lighthouse, which cannot be obtained with any other light. The importance of this may be understood from the fact that there are still many points around our shores that require lighthouses, but which must remain without them till better means of distinguishing them with certainty from others in the immediate neighbourhood can be employed; for having no lighthouse is hardly worse for the navigator than having two in sight which cannot be distinguished one from the other.

An objection has been made to this light, that, being so small, it would be altogether invisible at a considerable distance; and when we merely consider that the apparent size of distant objects depends on the visual angle, there seems to be some ground for the objection, but the law of visual angles does not apply in the case of self-luminous bodies, as can be demonstrated with this piece of fine wire, which, I suppose, is almost invisible, even with a strong light thrown on it, but now, if, by passing a current of electricity through it, it is made self-luminous, it appears gradually to increase in diameter as it becomes brighter; and as a curious fact, illustrating the difference between the theorist in his study and the practical observer, a sailor, who had seen the magneto light from a great distance, told me he supposed it must be at least ten feet in diameter. Another objection to the light is, that it is too bright; this may be an inconvenience in clear weather, but a light to be useful when most needed must be inconveniently bright in clear weather.

The last point to be considered is the cost of the magneto-electric light as compared with oil. The French director-general of lighthouses has made a report to his Government, both as to first cost and as to cost of maintenance; both are greatly in favour of the magneto-electric light: of course in making their calculations of cost, they take the cost of an equal quantity of light in each case, that is, by oil and electricity.

I have now only to remark, that this invention, if it may be called one, is purely English. Faraday commenced it when he discovered the fact that magnetism might be made to produce or induce an electric current; and although the magneto-light was first produced in Paris, it was by me; and so far from receiving assistance from any of the French *savans* in the matter, I was ridiculed by all of them for attempting what they said they could demonstrate was impossible. With regard to the regulator, which is also invented by me, there is another just invented by a Mons. Foucalt, on a very different principle, but which is quite as effective, though overloaded with clockwork. His regulator has this peculiarity: it can be used in a rolling vessel, and will bear with impunity the vibrations of a steamer.

METEOROLOGIC TELEGRAPHY.

MANY of our readers are, perhaps, not aware of the assistance the wonderful *forecasting* department of the Board of Trade derives from our telegraphic system. We quote the following interesting description of the services rendered from Admiral FitzRoy's new work, the "Weather Book:"—

"As an example of what has been done in this direction recently, under the auspices and by the powerful means of Government, authorised by Parliament, a brief *outline* will now be given of the practical system established at the Board of Trade with reference to Meteorologic Telegraphy: of its history, and the methods of present application; after which the more *difficult* parts of these subjects will be further treated—namely, their actual management in daily practice, the various conditions and circumstances under which the ever-changing states of atmosphere occur, and full explanation of the reasons for such decisions as are made in forecasting weather.

"In meteorology some degree of increased interest has been caused, not only by various discussions and publications, but by this organised system of forecasting weather, and giving cautionary notice of expected storms.

"In treating so complicated and extensive a subject as that of our atmosphere and its movements, it is extremely difficult to combine mathematical exactness with the results of experience obtained by practical ocular observation and much reflection; but to some extent this has been effected recently, the Board of Trade having arranged telegraphic and frequent communication between widely-separated stations and a central office in London, by which a means of *feeling*—indeed one may say *mentally seeing*—successive simultaneous states of the atmosphere over the greater extent of our islands was established, and an insight into its dynamical laws has been obtained, to which each passing month has added elucidation and value.

"Possibly at this time, when extensions of our arrangements to the Continent are established in France, and will be in Hanover and Prussia (although *here* there are still persons who doubt their utility), it may be desirable to give an explicit description of the basis, and the nature of the forecasts and occasional warnings which have been proved useful repeatedly during the past two years.

"The first cautionary or storm-warning signals were made in February, 1861, since which time similar notices have been given, as occasion needed.

"In August, 1861, the first *published* forecasts of weather were tried; and after *another* half-year had elapsed for gaining experience by varied tentative arrangements, the *present* system was established. Twenty-two reports are now received each morning (except Sundays), and ten each afternoon, besides five from the Continent. Double forecasts (*two* days in advance) are published, with the full tables (on which they *chiefly* depend), and are sent to eight *daily* papers, to one weekly, to Lloyd's, the Admiralty, the Horse Guards, the Board of Trade, and the Humane Society.

"The forecasts add almost nothing to the pecuniary expense of the system, while their usefulness practically is said to be more and more recognised.* Warnings of storms arise out of them, and (scarcely enough considered) the satisfaction of knowing that no very bad weather is imminent may be great to a person about to cross the sea. Thus their negative evidence may be actually little less valuable than the positive.

"Prophecies or predictions they are not; the term forecast is strictly applicable to such an *opinion* as is the result of a scientific

* At a meeting of the shareholders of the Great Western Docks at Stonehouse, Plymouth, it was stated officially that "the deficiency (in revenue) was to be attributed chiefly to the absence of vessels requiring the use of the graving docks for the purpose of repairing the damages occasioned by storms and casualties at sea." (In 1862.)

combination and calculation, liable to be occasionally, though rarely, marred by an unexpected "downrush"* of southerly wind, or by a rapid electrical action not yet sufficiently indicated to our extremely limited perception and feeling. We shall know more and more by degrees. At present it is satisfactory that the measures practised daily in these proceedings do not depend solely on any *one individual*, but are the results of facts exactly recorded, and deductions from their consideration, for which rules have been given. An able assistant shares their responsibilities *now*, and others are advancing satisfactorily in the study of dynamical meteorology."

INDIA TELEGRAPH DEPARTMENT.

COMPETITIVE EXAMINATION OF CANDIDATES FOR APPOINTMENT AS INSPECTORS OF THE THIRD GRADE IN THE TELEGRAPH DEPARTMENT IN INDIA, TO BE HELD IN LONDON IN MAY, 1864.

CANDIDATES must be native British subjects, and not less than eighteen nor more than twenty-four years of age, and must have complied with one or other of the three following conditions:—

1. They must have passed not less than two years in the service of one of the English telegraph companies, or of a foreign telegraphic administration; or,
2. Not less than two years as articled pupils of, or in practice under, a telegraphic engineer; or,
3. Not less than two years in a school or college recognised by the Secretary of State as possessing an efficient class for instruction in chemistry and physics, and during six months of that period must have given special attention to those subjects.

On these points they must be provided with satisfactory certificates, which must be delivered at the department of public works in this office between the 2nd and 18th days of May next, both inclusive, between which days only will applications be received.

The names of the candidates will then be registered, and they will be directed to appear for medical examination before the examining physician, who will attend at this office for the purpose on Saturday, the 21st of May, between the hours of one and three p.m. If then certified to be of constitutions sufficiently vigorous to bear the fatigue and exposure to which they would be liable when serving in India, they will be required to attend, at nine a.m. precisely, on the succeeding Monday and following days at a competitive examination which will be held in this office.

The candidates will first be required to write English from dictation, and, unless found able to do so with accuracy and facility, will not be permitted to remain during the subsequent examination. The other subjects of examination, and the maximum number of marks obtainable for proficiency in each class of subjects, will be the following:—

	Marks.
1. Arithmetic, book-keeping by single and double entry, mensuration	1,000
2. "Euclid:" 1st, 2nd, and 3rd books; and algebra, including simple and quadratic equations	1,000
3. Geography, plane trigonometry, including practical knowledge of methods for heights and distances, use of the logarithmic and trigonometrical tables	1,000
4. Elements of physics, including electricity and elements of chemistry	2,000

No candidate will be passed who shall not obtain 2,000 marks, of which not less than 1,000 must be awarded for physics and chemistry. The candidates who may obtain the prescribed minimum number of marks will be ranked by the examiners in the order of the numbers they may severally obtain; and of these the twenty-five who may stand highest on the list will be appointed.

The successful candidates must, within a month of their nomination, sign covenants, describing the terms and conditions of their appointment, and must embark for India when required to do so by the Secretary of State in Council, who will provide for the expenses of their passage. Any nominee not embarking when required will forfeit his appointment.

Present Classification of Appointments above the Grade of Signaller.

No. of Officers.	Grade.	Monthly Pay of each Officer.
		Rs.
1	Director-General	3,000
1	Director of Division	1,000 increasing by annual additions of Rs. 100 to a maximum of Rs. 1,500
2	" "	700 increasing by annual additions of Rs. 50 to a maximum of Rs. 1,000
1	Superintendent of Circle	700
2	" "	600
4	" "	500
5	" "	400
3	" "	350
15	Assistant Superintendents	300
20	Inspectors of 1st Grade	250
30	" 2nd Grade	200
40	" 3rd Grade	150

CORRESPONDENCE.

THE ATLANTIC TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Can you or any of your readers inform me what has become of the above important undertaking? It was stated in the daily papers, some months ago, that the necessary capital had been subscribed, the form of the cable decided upon, the arrangements with the contractors completed, the manufacture of the core commenced, and that an effort would be made to submerge the cable in the Autumn of the present year. I, like many others, who are deeply interested in the progress of submarine telegraphy, have watched with considerable anxiety for some public intimation as to the steps which are being taken towards the realization of the great object in view—the uniting the Old to the New World. The company has certainly the good wishes of millions on both sides of the Atlantic, and who will experience much disappointment if another year is allowed to pass by without an attempt being made to establish telegraphic communication between Valencia and Newfoundland. Yours, &c.,

Liverpool. J. P. LOVELL.

BONELLI'S TYPO-ELECTRIC TELEGRAPH.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It was my privilege on Monday evening last to attend the Conversazione at Angel-court, Throgmorton-street, to witness the Bonelli Typo-Electric Telegraph in operation. To say that I was exceedingly interested in the working of this beautiful and elaborate apparatus would be but a feeble expression of the feeling which had possession of not only myself but all present; and, indeed, if this most perfect of all methods of electrical communication were not sufficient to recommend itself and make its way to superiority over all others, sure I am that the gentlemanly courtesy and urbanity of Mr. Cook, the managing director, would make up the deficiency. Happily, however, so exquisite and yet so simple a contrivance carries with it its own indisputable credentials.

But I am not going to write a description of this delicate and effective typo-electric telegraph apparatus—hoping to see this done in your pages by some one more competent; and in order that such description should be comprehended by those of your numerous readers who have not seen the telegraph in operation, I would suggest that it be illustrated by diagrams, for the purpose of showing how and by what means the batteries act—how contact is made and broken at various points—and such other information bearing upon the internal mechanism which produces such unparalleled results. Considering the important end attained these appear to be few and comparatively simple; I apprehend, therefore, that a description given in accordance with this suggestion would be most interesting and within the comprehension of all.

Of course the object of this soirée was to bring the merits of the Bonelli telegraph more prominently before the metropolitan public, preliminary to a further extension of the line southward. This is an object which doubtless a great many people would like to see accomplished; and, indeed, it would be small credit to this metropolis if it failed to appreciate so perfect a system, when its merits have been so significantly acknowledged in the North and on the Continent.

Since, however, publicity is the object, it must necessarily be subjected to

* Herschel.

that ordeal which all claimants for public favour, no matter of what description, have to undergo—discussion on certain points connected therewith, which, unless some light can be thrown upon them, appear to be drawbacks or disadvantages.

To the thoughtful observer present on Monday night there was one consideration which, despite the general excellence of the system, could not fail to obtrude itself as a weak point. Suppose, for instance, the Bonelli Line of Telegraph was established between—say London and Manchester; suppose, further, that an important public meeting were being held at the latter place, and some famous orator was speaking there, upon whose lips the nation had learned to hang, and that a special edition of the *Times* was in process, getting his speech in type, fast as the electric wave flashed the words, warm from the fervid lips of eloquence along the wire,—how could those words be caught up and put into type by the type-layers, which are a necessary part of the staff of the Bonelli system of telegraphy? It seems to me impossible; and, therefore, for cases of this sort—which the Morse instrument is capable of doing with perfect ease, because no preliminaries are necessary, and which add so greatly to the income of existing telegraph companies—the Bonelli telegraph would seem to be inadequate. We know, of course, that the speed of transmission exceeds by far the Morse system, or even that attained by the use of Professor Hughes's instrument. But, then, there is the time it takes to *prepare for transmission* in the laying of the type, which, by passing through the apparatus at the sending station, prints it at the receiving station. By the ordinary telegraph, what with the use of abbreviations and other facilities, a speaker's words are transmitted with the same rapidity as they are uttered, so that we get a celebrated speech, delivered 200 miles away, wet from the press, almost before the thunders of applause have died away; or, at all events, before the enraptured audience have recovered the wonted use of their senses. On the other hand, it is inconceivable that the most expert type-layers should be able to get their characters in order with the same rapidity as an ordinary individual would speak. I shall be glad to know how this difficulty is got over, or whether we are to esteem the Bonelli Typo-Electric Telegraph as suitable only for the transmission of ordinary messages, in which there is always a sufficiency of time for setting up the type.

There are other points I should liked to have touched on, but I have already trespassed too far upon your space. The necessity of having five wires must be deemed not quite a favourable characteristic. I have an impression, however, that one wire might be made to answer the purpose.

J. P.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Being absent repairing one of the North Sea cables, I was only made acquainted, on my arrival here for shelter, through the kindness of one of our staff, of the invention of the pneumatic arrangement for discharing, &c., long submarine lines being attributed to Mr. Andrews.

Whilst employed in the engineering department I furnished a plan for the short circuiting apparatus at present used by the Submarine Telegraph Company on their Hanoverian and Danish cables, and Mr. Andrews, being engineer at the time, had the instrument manufactured.

Not the slightest alteration was ever made to my original suggestion.

Mr. Andrews' systems were far different from that explained at page 7 in the first number of your journal.

I am, sir, your obedient servant,

JAMES R. FRANCE,

Acting Engineer, Submarine Telegraph Company.

Off Yarmouth, January 12, 1864.

TELEGRAPHIC NEWS.

INTELLIGENCE has been received at the India Board of the safe arrival at Bombay of Lieutenant-Colonel Stewart, R.E., Sir Charles Bright, and staff of engineers, electricians, &c.

TELEGRAPHY IN NEW SOUTH WALES.—Although hardly five years had elapsed since the first introduction of telegraphy into the above colony there were, at the end of 1862, 2,174 miles of line and 2,539 miles of wire. The extension proposed for 1863 consisted of 120 miles of line, the average cost of construction being estimated at £40 10s. per mile.

ONE of the workmen, named Edward Hoy, in the employment of the Electric and International Telegraph Company, met with a dreadful and fatal accident while occupied in repairing the line wire near to the Corporation Bath, Chester. It appears that he was standing by one of the poles when the train to Chester came up and knocked him down, the engine passing over his head and killing him on the spot. We believe that accidents are of frequent occurrence along our telegraph lines from fall or the sudden fracture of the wire under great tension, &c., and also in some of the large factories, or on board vessels in submerging cables, &c.; but we believe that there exists no provident fund for the benefit of those who may meet with injury, or the families of those who may meet with fatal accidents, as in the case of men, &c., employed on our railways.

A LECTURE was delivered on the 6th inst., before the Philosophical Society, Ryde, by T. Webster, Esq., on "Recent Improvements in Telegraphy by Land and Water," illustrated by instruments, specimens of cables for ocean telegraphs, and diagrams. W. H. Anderson, Esq., the president of the Society, occupied the chair, and briefly introduced Mr. Webster to the meeting, and at the close warmly thanked him for the instructive and interesting facts he had laid before them; and all present heartily joined in their president's thanks for the really scientific and practical way in which he had treated the subject.

THE town and fort of Guadur was completely destroyed by fire on the night of the 23rd ult. Great distress in consequence. Guadur is due west from Kurrachee about 400 miles, the place at which the end line of telegraph from Kurrachee, intended to form part of what will be known as the Persian Gulf Line of Telegraph to England, terminates. The telegraph from Kurrachee to Guadur was completed in April last, under the superintendence of Mr. Walton.

PRESENTATION OF A TESTIMONIAL TO MR. W. H. PREECE, C.E.—On the 4th instant the various members of the staff of the south-western district of the Electric and International Telegraph Company, together with those of the telegraph department of the London and South-Western Railway Company, presented to Mr. W. H. Preece, their superintendent and engineer, a most gratifying testimonial of their regard and esteem, in the shape of a handsome gold chronometer watch, and an address on vellum beautifully executed by Mr. W. C. Clarke, of Southampton, to which is appended the names of the subscribers, about 150 in number. The presentation, which was made on Monday, was necessarily of a private nature, it being impossible for the subscribers to leave their respective duties to assemble in an aggregate gathering. The following is a copy of the address:—"To William Henry Preece, Esq. We, the following members of your staff, desire to present you with a testimonial of the esteem and deep regard entertained by us towards you as our superintendent. The marked progress of the district since it has been under your control—the hearty assistance, the able advice, you are ever ready to afford those under your charge—the unvaried kindness we have ever met with at your hands, have been to us a constant source alike of unqualified admiration and unbounded gratitude. Proud to possess as our guide and counsellor one who has on more occasions than once earned for himself the applause and the high reward of the Council of Civil Engineers, our earnest desire is that you may long remain amongst us, to watch over the interests of our employers no less than our own, to steer us on our onward course, our friend, our adviser; and that your life may be enriched with the greatest blessings a great and beneficent Providence has in its power to bestow. With these sentiments in our breasts we beg your kind acceptance of the accompanying watch." The watch bears the following inscription:—"Presented to William Henry Preece, Esq., by the various members of his staff, as a token of the high esteem and regard entertained by them for him as their superintendent. Southampton, December, 1863." Mr. Preece has acknowledged this very pleasing compliment in the subjoined letter to Mr. W. Langdon, who forwarded to him the address and watch on behalf of the subscribers:—"Southampton, January 5th, 1863. Dear Sir,—I beg to return to you personally, and to the members of my staff generally, my sincerest and deepest thanks for the very handsome testimonial which you have presented to me. I do not know that anything could have been done by those with whom I have been so long associated which could have afforded me greater pleasure. I can never contemplate this splendid watch, nor read this eloquent address, without feeling that, however much I may have failed in doing my duty, I have at least gained your regard and esteem. This of itself is a proud satisfaction, without which the gratifying present that accompanies the kind expression of your approval of my conduct as your superintendent would be valueless. I hope I shall continue to merit your goodwill, I will at least endeavour to deserve it. And I trust that we may be long spared to carry on the duties, which have hitherto been so amicably and happily conducted, with the same confidence, the same satisfaction, and the same success. I am, yours very faithfully, W. H. PREECE." Our readers are aware that Mr. Preece is a man of considerable scientific attainments. Two papers written by him and read at the Institution of Civil Engineers, London, of which he is a member, have earned for him—the one on "Submarine Cables," the Telford gold medal, and the other, on "Railway Telegraphs," the Telford premium, being an award of books valued at £30. These papers have both been printed by the institution, and afford much valuable information on the respective subjects of which they treat. The last-named is a work of especial interest, not only to railway managers, but to the travelling public at large. Pointing out the various systems in force on different railways, the author enters into a clear and impartial discussion of their relative merits and disadvantages, with the laudable view of introducing and maintaining such systems only as shall tend, as far as it is possible, to procure security for life and regularity in the traffic. Mr. Preece's contributions to the scientific journals of the day have been by no means scanty. As an electrician he has introduced many improvements in telegraphy, and his system of railway signalling is the most perfect and simple of the day. On many occasions Mr. Preece has rendered good service to the Polytechnic Institution of Southampton and kindred associations in the neighbourhood, and we are glad to have this opportunity of recording the high esteem in which he is held by those with whom he is so closely and intimately connected in business relations.

TELEGRAMS for India will for the future be transmitted from the chief office of the Submarine Telegraph Company, Threadneedle-street, to Marseilles direct, instead of to Paris as heretofore. This will make considerable difference in the time occupied in the transmission of Indian intelligence.

BOARD OF TRADE, WHITEHALL, JAN. 7.—The Right Hon. the Lords of the Committee of Privy Council for Trade and Plantations have received, through the Secretary of State for Foreign Affairs, a copy of a despatch from Her Majesty's Chargé d'Affaires at Constantinople, enclosing a copy of a notice communicated to him by the Director-General of Turkish Telegraphs, to the following effect :—"The Imperial Administration of the Ottoman Telegraph gives notice to masters of vessels that a submarine telegraph cable has been laid in the Straits of the Dardanelles, between forts Bokhalé (coast of Europe) and Negaras (coast of Asia). It is forbidden for any vessel to anchor in the vicinity of the cable, under penalty of all loss or damage resulting thereby."

THE OTRANTE AND AVELONA SUBMARINE CABLE.—In a former number we briefly referred to the completion and shipment of the above cable on board the *Semaphore*. The vessel left Mr. Henley's, the contractor's works at North Woolwich, on the 7th instant. The cable is 62 miles (statute) in length, 43½ miles of which is to be submerged in deep, and 18½ miles in shallow water. Six miles of the shore end are covered with Messrs. Bright & Clark's compound. The conductor was covered by the Gutta Percha Company, of Wharf-road, City-road, E.C., with three coatings of gutta percha and Chatterton's compound to No. 0, then served with towed hemp, and finally with a sheathing of galvanized iron wire. The insulation of this cable is considered superior to any hitherto manufactured, which affords satisfactory proof that great improvements are taking place in the preparation and application of insulating materials, and which must tend greatly to the advancement and progress of submarine telegraphy.

THE MAGNETIC TELEGRAPH COMPANY'S ANNUAL DINNER.—On the 6th inst. the gentlemen connected with the above company entertained themselves at the Canton Hotel, Temple-court, Liverpool, to a capital entertainment, comprising the essentials of an Englishman's life. It has been customary to hold in years previous to the present an annual tea party; but, whether a change of diet was required or not, the present year was not inaugurated with a tea party. The company mustered in good force, and the table was presided over by Mr. E. B. Bright, the vice falling to Mr. J. Leyland. The President, after proposing the usual loyal toasts, tendered "Success to the Magnetic Telegraph Company." In so doing, Mr. Bright pointed out the experience of many years; and stated that, in 1852, when the company was first formed, the number of stations established by the company was four or five, which, of course, embraced but a small degree of the existing position of the company. At the present time the wires of the company embraced 17,000 miles, and these miles were junctionised at different points by 500 stations. This epitome, of course, is conclusive evidence as to the good management and perspectiveness of the company; and when it is added that, within a few months, the wires of the company will extend directly from Liverpool to India, it is unnecessary to add a good and grateful compliment to those who direct the management of the Magnetic Telegraph Company. There were numerous toasts proposed and responded to. Mr. J. L. Walsh, in happy and appropriate terms, proposed "the Health of the Chairman," which was responded to in a speech which elicited from those present expressions of good hope that in future years the Magnetic Company would still inaugurate the commencement of each year by an assemblage which embraced all good and kindly feeling, and which tended and at the same time made those connected with the Magnetic Telegraph Company more happy, more genial, and more fruitful in their labours to the company and themselves.

MISCELLANEA.

THE duties of a clerk of the telegraph would be extremely simple, requiring only accuracy and attention in noting down and transmitting notices, with a certain degree of expertness, easily attained, in working the instrument. These qualifications are frequently possessed, in a remarkable degree, by a very deserving class of persons, to whom our state of society has hitherto assigned no congenial occupation. The deaf and dumb might, in the telegraphic department, find employment peculiarly suited to their education and powers. Accustomed from their infancy to abbreviate as far as possible, by signs, their symbolic language, they would quickly attain a degree of conciseness in spelling, which, in addition to the omission of the smaller words, would enable them to transmit, with astonishing rapidity, a lengthened despatch; whilst a habit of attention enforced by their infirmities would be favourable to the accurate performance of their duties. The idea of uniting a great political and mercantile enterprise with a charitable object may excite a smile, but cannot diminish the value of the undertaking in the eyes of those whose support the writer is most anxious to secure. It may be observed that a method as effectual as the alarum for those who can hear may be employed in connexion with this instrument to awaken the deaf from the soundest sleep.—*W. F. Cooke's Pamphlet in* 1836.

CANDIDATES for the vocation of telegraph clerks should be capable of writing a free and distinct hand, of spelling correctly, and, as correspondence will form a portion of their duties, of adapting their communications to grammatical formula; a slight acquaintance with arithmetic is also essential; higher attainments than these are not actually indispensable to the ordinary clerk, although they may realize to their possessor advantages which the less accomplished would scarcely have reason to expect or hope for. An "instrument clerk" may be quite competent to telegraph or receive a despatch in a foreign language, and yet not understand a single word of it; but, as the Continent and many other parts of the globe are intersected by the telegraph, clerks and other officials must of necessity be located in foreign countries, and to those who are privileged with such stations the qualifications of a linguist will form an important element in moulding the eventualities of their career. That foreign situations are generally more lucrative than appointments in this country is an admitted fact, and when they are at disposal it is obvious to whom the preference would be accorded, unless favouritism or interest interpose; besides there are foreign departments, attached to which are numerous *employés*, in the chief home offices of the British telegraph companies, to which clerks who are conversant with the language of other countries may be drafted. Although allusion has been made to the favourable circumstances under which the accomplished scholar identifies himself with the service of those companies that have direct communication with other nations, it must not be construed that the official who is destitute of such acquirements should consider his position to be stationary, as, on the contrary, his course may be a progressive one. Constant practice enables him to signal—*i.e.*, to send and receive messages and to write with celerity; and if he applies himself to his duties as assiduously as is expected of him, and determines upon becoming acquainted with the why and the wherefore, he may not only render himself a proficient instrument clerk, correspondent, and accountant, but also attain to a thorough knowledge of the principles of electricity, which operates so surprisingly and with such exquisite accuracy in exchanging thoughts, although conceived in different climes and hundreds of miles apart, with the rapidity of lightning, hence annihilating distance and concentrating time, conveying tidings of the movements of an army, the rise and fall of dynasties, or the desires of a peasant, with like facility and marvellous speed. If the acquisition of a knowledge of the mysteries of this wonderful agent be the clerk's ambition and aim, opportunity will aid the will in demonstration of the fact that the zenith of his aspirations is within his flight, and perhaps assist in distinguishing him as an illustration of the truthfulness of the poet's sentiments—

> "There is a tide in the affairs of men,
> Which, taken at the flood, leads on to fortune."

In the telegraph management there is a feature that is especially commendable. We allude to the solicitude for the development of the mental faculties, as evinced by the establishment of a free library of good, useful, and entertaining works, treating on all subjects, which are at the disposal of the clerk, who has generally an abundance of time to devote to the mind's culture; the means, therefore, of enriching himself in knowledge are within his reach—a literary repast is spread, and he is invited to partake of it. The various grades in the correspondence, and the higher positions in the engineering department, shines forth in the prospective as stimulants to exertion—as rewards to diligence, perseverance, and adherence to the regulations laid down for his guidance. The juvenility of many of the clerks denotes a freshness to business—a recent withdrawal from school to take part in the active concerns of life. Youths of fourteen are deemed eligible for the post, and sharp intelligent lads sometimes enter the service even at an earlier age, and the employment seems so congenial to their taste, that, unlike other tasks, it is viewed by them with the pleasurable emotion of an agreeable pastime; nor does this feeling abate—it grows with their age, and, as a consequence, they frequently out-distance those whose induction dates at a later period of life, and hence earn for themselves the reputation of first-class readers.—*Bond's Handbook of the Telegraph.*

ENERGY.—The cultivation of this quality is of the greatest importance; resolute determination in the pursuit of worthy objects being the foundation of all true greatness of character. Energy enables a man to force his way through irksome drudgery and dry details, and carries him onward and upward in every station in life. It accomplishes more than genius, with not one-half the disappointment and peril. It is not eminent talent that is required to ensure success in any pursuit, so much as purpose,—not merely the power to achieve, but the will to labour energetically and perseveringly. Hence energy of will may be defined to be the very central power of chaacter in a man—in a word, it is the Man himself. It gives impulse to his every action, and soul to every effort. True hope is based on it,—and it is hope that gives the real perfume to life. There is a fine heraldic motto on a broken helmet in Battle Abbey, "L'espoir est ma force," which might be the motto of every man's life. "Woe unto him that is faint-hearted," says the son of Sirach. There is, indeed, no blessing equal to the possession of a stout heart. Even if a man fail in his efforts, it will be a great satisfaction to him to enjoy the consciousness of having done his best. In humble life nothing can be more cheering and beautiful than to see a man combating suffering by patience, triumphing in his integrity, and who, when his feet are bleeding and his limbs failing him, still walks upon his courage.

AN instrument, called the "Bathorèomètre," has been invented by Messrs. Ludwig & Kromeyer, of New York, on the principle of closing the electric circuit by means of a substance interposed between the electrodes, by which thicknesses of substances, such as hair, spiders' web, &c., may be determined with exactness to the twelve-millionth part of an inch.

THE inventive genius of swindlers seems to keep pace with the improved means brought to bear for effecting their apprehension or in defeating their schemes upon the purses of the credulous. A good illustration of the fertility of invention displayed by those rogues who live upon their wits was furnished in Liverpool lately. It appears that a respectably-attired young man went to the house of Mrs. Stower, No. 4, Bedford-street North, and stated that he was a telegraph clerk, that a telegram had just arrived from a "foreign country," and which could only be delivered to Mrs. Stower or her husband. The "clerk" told Mrs. Stower that if she sent her son down with him to the house of Mr. Roberts, the Secretary to the Electric Telegraph Company, who resided in Hope-street, he would send the message to her. Mrs. Stower sent her son with the man as he desired; but on the way to Hope-street the fellow told the lad that he must return and bring with him 7s. 5d., or he could not have the telegram. The lad returned as desired, brought the money, which he handed to the man, who gave him in exchange an envelope, which he said contained the "message." The lad returned home and gave the envelope to his mother, who, when she opened it, found that, instead of containing the expected telegram, the only thing inside was a blank sheet of paper. Mrs. Stower went to the detective-office and informed the police as to what had taken place. On leaving the office and proceeding along Whitechapel she met the person she so much desired to have an interview with—"the telegraph clerk" who had called upon her in the morning. Mrs. Stower at once gave the fellow into custody, and on being taken to the police-office he gave the name of James Taylor, and said that he was a surgical instrument maker. Mrs. Stower is not the only person whom he has victimised, for other complaints have been made at the detective-office by parties who have paid for Taylor's "messages."

SINGULAR MODE OF CAPTURING GYMNOTI.—The marshy waters of Bera and Rastro are filled with innumerable electric eels, who can at pleasure discharge from every part of their slimy yellow-speckled bodies a deadening shock. This species of gymnotus is about six feet in length. It is powerful enough to kill the largest animals when it discharges its nervous organs at one shock in a favourable direction. It was once found necessary to change the line of road from Uritneer across the Steppe, owing to the number of horses which, in fording a certain rivulet, annually fell a sacrifice to these gymnoti, which had accumulated there in great numbers. All other species of fish shun the vicinity of these formidable creatures. Even the angler, when fishing from the high bank, is in dread lest an electric shock should be conveyed to him along the moistened line. Thus, in these regions, the electric fire breaks forth from the lowest depths of the waters. The mode of capturing the gymnotus affords a picturesque spectacle. A number of mules and horses are driven into a swamp, which is closely surrounded by Indians, until the unusual noise excites the daring fish to venture on an attack. Serpent-like they are seen swimming along the surface of the water, striving cunningly to glide under the bellies of the horses. By the force of their invisible blows numbers of the poor animals are suddenly prostrated: others snorting and panting, their manes erect, their eyes wildly flashing with terror, rush madly from the raging storm; but the Indians, armed with long bamboo staves, drive them back in the midst of the pool. By degrees the fury of this unequal contest begins to slacken. Like clouds that have discharged their electricity, the wearied eels disperse. They require long rest and nourishing food to repair the galvanic force which they have so lavishly expended. Their shocks gradually become weaker and weaker. Terrified by the noise of the trampling horses, they timidly approach the brink of the morass, where they are wounded by harpoons, and drawn on shore by non-conducting poles of dry wood. Such is the remarkable contest between horses and fish. That which constitutes the living but invisible weapon of these inhabitants of the water—that which, awakened by the contact of moist and dissimilar particles, circulates through all the organs of animals and plants—that which, flashing amid the roar of thunder, illuminates the wide canopy of heaven—which binds iron to iron, and directs the silent recurring course of the magnetic needle—all, like the varied hues of the refracted ray of light, flow from one common source, and all blend together into one eternal all-pervading power.—*Baron Von Humboldt.*

PRICES CURRENT OF INSULATING MATERIAL

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities. . .	2/6	per lb.
Good re-boiled	1/7 to 1/10	„

INDIA RUBBER.

Para, first quality	1/10 to 1/11	„
second „	1/7 to 1/8	„
third Negro-head	1/1 to 1/2	„
Java and Penang	1/4 to 1/6	„

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	107 to 110	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	3/8 to 5/8	—
5	United Kingdom Telegraph .	3	¾*d* to ½*d*.	—
10	Mediterranean Extension Tel. .	all	2½ to 3½	—
5	London District Telegraph Co..	all	1½ to 2	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Several inquiries having been addressed to us respecting the India telegraphic appointments, we have inserted in another portion of the journal the instructions issued by the India Board.

It is our intention to publish in our columns a historical account of the late extensive experiments carried on under the direction of the Telegraph Committee of the Board of Trade, together with the result of numerous investigations which are not included in the "Blue Book."

The review of Mr. Culley's new work, and the continuation of our article on Telegraph Property, are unavoidably postponed until next week.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street West; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms (paid in advance):—

	s.	*d.*
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	*s.*	*d.*
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto.	1	7	6
Four lines and under (single column)	0	3	0

Single Advertisements from the country must be accompanied with stamps in payment.

THE TELEGRAPHIC JOURNAL.

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THE MALTA AND ALEXANDRIA CABLE.

WE are sorry to have to announce that the above important line of Submarine Telegraphy has again ceased to act, and more so as we are informed that, had there been a ship furnished with the proper appliances for raising and repairing the cable, the interruption would have soon been removed. It is believed that the injury has been caused by the severance of the cable by an anchor, and in a locality where no difficulty presented itself to effect a speedy restoration of the communication, had there been, as we have already observed, a ship available.

With the princely revenue which this line yields, it is much to be regretted that no ship is kept ready on the spot, to repair such injuries as might occur. We believe that the lessees have made every effort to perform their obligations to the Government and the public. They certainly did not bargain to keep a vessel always in readiness. The Government, on its part, has failed in its duties. It is well known that there were vessels at Malta, on other occasions, which the lessees could have easily fitted up with the necessary apparatus for raising and repairing the cable, but the loan of such vessels was refused. The lessees were compelled, as they are now compelled, to resort to our ports at home, for a vessel for the purpose. The stoppage and the delay which must, of necessity, take place before the communication is renewed, are of serious consequence to the public and our telegraph companies, more especially to the Submarine Telegraph Company, who, in order to meet the public requirements incurred considerable expense in providing instruments, manipulators, &c. We believe that, since the interruption has taken place, the loss to this company alone is upwards of 120 messages per day; but the loss to the public is still greater, and the more annoying, because it must extend over as many days as it ought to have been hours.

Notwithstanding these mishaps, we are exceedingly glad to be in a position to assure the friends of submarine telegraphy, and the public generally, that the line between Malta and Alexandria is in an excellent state of preservation, exhibiting no signs whatever of deterioration in its electrical condition. The messages are now transmitted per telegraph to Malta, where they are posted and conveyed from that station to Alexandria. As Parliament soon meets, we hope that the non-fulfilment of the terms of the lease, on the part of the parties concerned, will be brought before it, and that the matter will be thoroughly sifted. The following are the clauses to which we have referred:—"In case at any time during the continuance of this lease it shall be necessary to take up any part of the cable, which cannot be taken up by the use of small boats, for the purpose of repairing the same, the same shall be taken up and repaired, or replaced, by the lessees, and the expenses borne and paid in manner following, viz.:—'If any Government vessel, suitable for the purpose, shall be then at Malta, and shall not be required for other purposes (of which the Government shall be the sole judge), the Government shall, or if any other Government vessel suitable for the purpose can be furnished, the Government may, if they so think fit, lend such vessel to the lessees, for the purposes aforesaid, providing such vessel with officers and crew, and defraying all such expenses as shall be required for, or incurred in and about the navigation of the said vessel, other than the expense of coals and fuel, which shall be at the joint expense of the Government and the lessees, but all necessary fittings, to adapt such vessel for the purpose of raising and re-placing the said cable, shall be placed in such vessel, and shall be afterwards removed and the said vessel restored to her original state and condition, by and at the expense of the lessees; and all machinery, apparatus, and instruments, which shall be necessary for the purpose of raising, repairing, and laying the said cable; and the engineers, electricians, and cablemen, shall be provided, maintained, and paid, by and at the expense of the lessees. If no such vessel shall be furnished by the Government, the lessees shall provide a suitable vessel, and shall provide officers and crew for the same, the hire of which vessel, and the hire and maintenance of the captain and crew, and all such other expenses as shall be required for, or incurred in or about the navigation of the said vessel, and also the insurance of the said vessel, shall be at the joint expense of the Government and lessees, but all other matters shall be provided and done, and all expenses borne in the same manner as if such vessel had been a Government vessel, and lent to the lessees for the purpose aforesaid.'"

THE FIRE BRIGADE TELEGRAPH.

CAPTAIN SHAW, the Superintendent of the London Fire Brigade, has recently issued his Annual Report for the year 1863.

It contains a general statement of the working of the Brigade, with interesting returns, showing the number, cause, locality, and other particulars of the various fires that occurred in London and the suburbs during the year. The following extracts may prove interesting to many of our readers:—

"During the past year the telegraph has been extended from the foremen's stations to those in their respective districts, thus completing the communication throughout the establishment, from the chief station, in which I reside, to those most remote—in Ratcliff, Baker-street, Westminster, and Rotherhithe respectively. The system which I have adopted is of the simplest possible kind, as will be seen by reference to the accompanying map. Every line is complete in itself, with a dial or alphabetical instrument at each end; thus, a stoppage or break in any one line does not interfere with the general communication, as would be the case if several stations were on one circuit. From Watling-street I ordinarily communicate only with the foremen, and through them with the stations in their respective districts; but, by a simple contrivance, I can at any moment be placed in direct communication with any station, thus avoiding the delay caused by repeated messages at an intermediate point. I have adopted this mode not only to be able to collect the necessary force of men and engines at any given spot, in the shortest possible time, according to my requirements at the moment, but also for the purpose of avoiding the errors inseparable from a system of mere alarms, as used in America, by which the whole force of a fire brigade is liable to be constantly turned out for matters of very little consequence, it being an invariable rule that the importance of every fire is greatly exaggerated by momentary panic in the vicinity. The saving thus effected in the time and labour of the men, as compared with the old system of running with 'calls and stops' from station to station, is in itself a great addition to the available strength of the establishment, and that at the very time when the services of skilled firemen are most needed, while the

advantage of rapidly transmitting the calls, and thus ensuring the early arrival of men and engines at fires, is incalculable; besides which I am now enabled to issue orders and conduct almost the whole of the duties of the establishment by this means in a much quicker and more satisfactory manner than formerly."

It may also be stated that, taken in a pecuniary point of view, the addition of the Telegraph to the Fire Brigade System has proved most satisfactory. The amounts hitherto paid for "calls," whether for actual fires or false alarms, have formed a large item of expenditure in the management, as, in addition to the fees paid, the expense of sending out the engines must be taken into consideration.

At some of the stations this service is done by contract, *i.e.*, the necessary number of horses is provided by the contractor, and a charge made each time they are sent out.

An elaborate diagram accompanies the Report, showing the connections of the various stations as explained in the foregoing extract.

The wires and instruments have been provided by the London District Telegraph Company, the latter being made by Messrs. Siemens & Halske. The magneto-alphabetical instruments have been adopted; and, from their extreme simplicity and durability, they are well suited for this service.

We understand that the Dublin Fire Brigade are also having a Telegraph provided for their service, as well as several other large towns in the north of England.

AMENITIES.

Probably some of our readers will not have forgotten the sentiments that were dropping from the lips of the good and eloquent Judge Talfourd, when the icy messenger summoned him without warning from the head of an earthly tribunal—from the judicial bench to which he had been but recently elevated to grace and adorn, and while even the ermine which he honoured sat new upon him—to a higher tribunal, before which may we all be as well fitted to appear. He was deploring the grievous effects of class exclusiveness, and dwelling upon the probable decrease of those painful cases which wound the susceptibilities of the tender-hearted judge, who in the worst of cases cannot but sympathise with the fallen, and speculate reflectively how different things might have been had the circumstances been other than they were, and how often (too often, alas!) those circumstances—made by others, unnecessarily—prove gratuitous fabrications not to be laid at the door of Providence, as men so often find it convenient to do, while the wretch who suffered was not unfrequently the victim of those very man-made circumstances, with perhaps neither the power nor the will to control them.

These eminently humane sentiments met with a response in the breast of every right-minded man and woman throughout the land, especially when they were taken in connection with the awful circumstances of their being spoken on the confines of the unseen world, for it was like a voice from the land of spirits. These words, perhaps, were not spoken in vain. The impenetrable barriers of ice which erst had separated class from class had been thawed by real sympathy to no inconsiderable extent. Nevertheless it makes one shudder when facts come to light at times which reveal that there are myriads existing in a mysterious isolation, as much cut off from the sympathy of the rest of the world as the natives of Patagonia, or the extinct Artures of the Orinoco. Speaking of the nation as a whole, the social fabric is not inaptly compared to an edifice which a skilful builder has put together. The "upper ten thousand" form the dome, and royalty is its apex. Trace the building throughout its fair proportions down to the foundations. What does so noble a temple rest upon? Surely it should be founded on a rock. The lower tiers, basement, and foundation of this towering edifice, whose summit glitters in the empyrean, are formed by the labouring and artizan class. How are they cemented to the layers above? It were hardly wise they should be as lose disjointed fragments of brick, lath, and plaster.

There is, however, a class exclusiveness on a less important scale than this, and, indeed, where one would think it was the interest, at least of the more fortunate part, to render its existence as indistinct and innocuous as possible. Generally speaking no sympathy can be said to exist between employer and employed. The former—having capital to offer in return for the skill and labour of the million, whose only capital is brains and sinew—too often look upon the connection as an ordinary affair of barter, and each party is as much a stranger to the other until the contract is renewed as it is possible for two distinct races to be. This is a general view of the subject, and by no means an agreeable one, taken in connection with the structural fancy above indulged in.

Inter alia, we have been led to make these remarks from the numerous letters which have appeared from clerks and other employés of the different Telegraph Companies, complaining of the unjust aspersions cast upon them from their alleged inferiority in intelligence, and their meagre attainments in electric and telegraphic science, as compared with the same class of persons on the Continent. Such comparison is, to say the least, invidious; nor has it any foundation in fact, so far as we are able to judge. Doubtless there are continental clerks and workmen too, that could put to the blush many holding far higher situations in this country; they are not a type of the class, however, but rare exceptions only, no more indigenous to one country than another. We are personally acquainted with more than one or two individuals, our own countrymen, occupying but very humble stations, who have far sounder and more matured views on electrical and telegraphic points, theoretical and practical, than many eminent men who are nevertheless justly esteemed authorities in their profession: indeed, we are free to admit that ourselves have sat at the feet of these lowly individuals and been all the wiser for it. Gentle souls! they are too modest, and think too lightly of their acquirements ever to become men of note; but an apt man will borrow their brains, or the results thereof, and will become eminent, perhaps rich, by virtue of the possession.

Besides these rare exceptions, however, there is a large number of our telegraph clerks who are really men of superior attainments to the common run of clerks, and are quite posted up in all the generalities appertaining to matters electric and telegraphic; and that there are not more such is, perhaps, as much owing to themselves as the companies' officers they serve under. So much by way of vindication.

We confess we should like to see a greater degree of interest taken in the welfare of so large and important a class as the telegraph clerks and employés; certainly a great deal has been done of late, and there is no better lesson to inculcate than that of self-help; but it is hardly in this direction that our remarks are intended. We are desirous of seeing that spirit of amity pervading the whole mass, from the Board of Directors down to the meanest messenger boy, which alone is capable of cementing them into a body fitly represented by a super-structure, compact and harmonious in its graceful gradations.

No one, we think, can charge any of our large Telegraph Companies with parsimoniousness in respect to the recompense of those they employ, but too often those in authority are apt to overlook the fact that they owe something more to their servants than mere payment for time and labour. A congenial spirit should be evinced, and a familiarity cultivated which need not degenerate into contempt, so that while the one can look up with respect and esteem, the other may courteously show by general urbanity of demeanour that the social status which

renders one distinct from the other is not allowed to obtrude itself in so objectionable a way as to cause the less fortunate to feel himself humiliated on account of his social position. Surely the application of the greatest agent in nature to the requirements of mankind, and the well-being and advancement of the world at large, ought to afford common ground whereon the humblest aspirant after scientific truth and progress should feel himself on a level with a peer of the realm engaged in the same pursuit.

As one means to this end, Directors of Telegraph Companies cannot assuredly do better than contribute by all possible means to render their clerks efficient for the performance of their duties. It is their interest to do so, and surely that is the lowest motive that can be urged.

The establishment of circulating libraries for the use of the employés, embracing every known work of merit on electrical, telegraphic, and kindred sciences, would do much to bring the ordinary working staff into a state of most satisfactory efficiency; nor would it be waste of the companies' funds to distribute gratuitously the current periodical literature of telegraphy among those of their servants to whom a few pence per week is a tax they can ill afford to subject themselves to. It would keep them wide awake to what is going on; they would become interested in matters which probably they never hear of now; and the zest thus created for general as well as specific telegraphic information would bring out latent talent, and in the main repay the outlay tenfold.

Such a company's business would be certain to be done well and efficiently; there would be a stimulus to exertion, and most of all, it would foster the growth of that bond of brotherhood which we conceive to be the nearest approach to a perfect state of society. We shall take an early opportunity of addressing a few words to telegraph clerks, &c., especially.

M. S. B.

MR. R. S. CULLEY'S NEW WORK.*

(*Continued from p.* 16.)

NOTHING is more important to the telegraphist than a thorough knowledge of the laws of resistance, and their application to the testing of lines for efficiency, and for the existence of faults. All principal circuits should be regularly tested daily. These tests should be so recorded, as to be capable of being reduced into units of resistance. The unit of resistance adopted in England, is a single mile of No. 16 copper wire. Such tests will show leakages, and faulty connections, and frequently enable their removal to be effected before they have succeeded in preventing the efficient working of the circuit. Mr. Culley describes the system adopted in France, as described by M. Blavier, but the plan used in England by which these tests are made with differential galvanometers and resistance coils, is far more exact and simple. It is quite possible to reduce the readings of a galvanometer to units of resistance, with much exactitude, but it is far preferable to take these facts direct by the aid of coils.

Part VII. details the nature and effect of faults, and the various methods adopted in discovering them, and their positions. Very little has ever been published upon this matter before, and, if we except a pamphlet by Mr. C. W. Siemens, F.R.S., and a paper read at the Institute of Civil Engineers by Mr. W. H. Preece, we do not know of any printed matters containing the important information required for this branch of the telegraphic calling.

Mr. Culley gives the following important advice:—

Never test for contact by having the earth put on at the testing stations; this method is liable to great error, and has led to much inconvenience.

If *a very good* earth be put on *beyond* the fault, and very near it, it will cause the contact to disappear almost entirely, because the resistance of this new path will be very much less than that of the other wire.

And if the earth be *imperfect*, and be put on between the original station and the fault (the near side of the fault), the contact will not disappear, especially if the wires be clean, so that the resistance of the points in contact be very little.

The fault may appear less, but unless care is taken that the testing battery be not strong enough to give a "*full deflection*" the variation in the resistance of the circuit may escape notice.

The following is new and useful:—

In a tunnel the place of a fault may be found thus:—Put a current of 40 cells, or more, upon the wire at the mouth of the tunnel, disconnecting the other end. Wrap one bare end of a piece of covered wire with wet cotton waste, and connect the other to a detector in connection with the rail. Run the waste along the wire, carrying the detector forward until the needle is deflected by the current escaping through the waste at the fault. The detector may be fixed to a staff ending in an iron point, which can be set upon the rails, which should be moistened to make good earth. The wire may also be cut and tested in sections.

Indeed, this part is full of interesting matters, and very sage and useful advice. We can only regret that it is not more copious.

The remaining portion of the work is devoted to a description of the various signal apparatus employed in telegraphy:—switches, commutators, keys, turnplates; the printing and needle telegraphs; the construction of a line; and the strain and dip of suspended wires. The latter information is particularly interesting, and should be carefully studied by those who have the charge of those tremendous spans that cross the streets and waterways of our metropolis. The mathematical formula of the law of the question is:—

$$S^2 : s^2 :: D : d.$$

Where S is the original span, s the proposed span, D the original dip, and d the dip required by the increased span, to preserve the same strain and tension. From this formula may be ascertained "not only the dip of any proposed span, but the span of any proposed dip."

A wire should never remain tightened up to more than one-fourth of its breaking strain, which varies with every sample of wire. It should be pulled up first to one-half of the breaking strain to test it, and afterwards slacked out. Where the breaking of the wire would be inconvenient, it may be tested before it is put up.

An appendix is added, containing some very valuable and instructive notes. Those relating to the construction of scales, for tangent and sine galvanometers, are particularly useful.

We cannot too heartily thank Mr. Culley for the very useful addition he has made to our literature, and we only wish that other celebrities in this science would follow his meritorious example. There is nothing gained by unpublished experience. It is far better to throw it widecast over the profession. Telegraphy is a science in its infancy, and it is only by such labours as those of Mr. Culley's that it can ever be brought to maturity. An eminent philosopher once said, that he found as much pleasure in imparting knowledge as he had received in acquiring it, and we can only wish that the same sentiment would occupy the minds of our own electricians. It is because our own telegraph engineers have been so chary in wielding the pen that they are held in such little repute in the scientific world, at home and abroad; whereas, really, if the truth were known, it would be found that we possess in England talent of the deepest kind, and genius of the profoundest nature. Victories, as proud as those of Waterloo or Trafalgar, have been gained in the field of telegraphy, but we have missed the chronicler to immortalise them. We hope Mr. Culley has commenced a new era.

* A Handbook of Practical Telegraphy. By R. S. CULLEY, Telegraphic Engineer and Superintendent. London: Longman, Green, and Longman.

OCEANIC TELEGRAPHY.

I. *The Deep-Sea Bed of the Atlantic and its Inhabitants.*

By Dr. G. C. WALLICH, F.L.S.

[A HIGHLY interesting and instructive Paper, contributed by Dr. G. C. Wallich, a gentleman well known for his deep-sea soundings and investigations, and the valuable services rendered by him to the science of submarine telegraphy, appears in the first number of an excellent publication recently established under the title of "The Quarterly Journal of Science."* Dr. Wallich accompanied the expedition which sailed under the command of Captain McClintock to survey the proposed northern route for an Atlantic

* John Churchill & Sons, New Burlington Street.

Telegraph; and the valuable information which he then obtained, and in a subsequent survey of the bed of the Atlantic, renders the Paper peculiarly interesting at the present moment, when the subject of deep-sea telegraphy engages so much of the attention of the scientific and commercial portion of the community. We also trust that the perusal of the Paper now re-produced in our columns will be the means of inducing many of our readers employed in telegraphic pursuits, as engineers and electricians, to study a subject, a knowledge of which must greatly tend to promote their success in a new but honourable profession.]

The sounding-machine has already conducted us to the confines of an unexplored world. It has enabled us to penetrate the secret so long and so stedfastly concealed by nature beneath the waters of the ocean, by placing within our grasp the still living forms of creatures differing in no material respect from some of those inhabiting moderate depths, yet capable of sustaining existence under the extraordinary conditions known to prevail amidst the more profound abysses of the sea-bed. In short, it has taught us that our preconceived views concerning the incompatibility of these conditions with the performance of functions which are essential to life, are erroneous, and demand most careful revision.

The fact, as thus stated, appears simple enough, and may by many persons be regarded as involving purely scientific issues. It will be our aim, however, to show that this is by no means the case; and that, whilst the interest attaching to the discovery of animal life under such circumstances is undoubtedly great, and likely to lead to valuable results in every department of Natural History, the practical bearing of this discovery on the question of Oceanic Telegraphy is of no less important a character. But in order to render ourselves intelligible, we must briefly direct attention to what was known on the subject prior to the time when it assumed its present aspect through the discovery of living star-fish procured from a depth of nearly a mile and a half below the surface.

Without stopping to notice the various conjectures regarding the nature of the deep-sea bed which had previously been hazarded, it may suffice to mention that specimens of the material of which it is composed were, for the first time, systematically obtained about ten years ago. These consisted, for the most part, of an extremely fine mud, with a large proportion of microscopic shells belonging to one of the simplest forms of animal life with which we are acquainted. Some of the shells retained a considerable portion of the gelatinous substance of which the bodies of this class of organisms is composed. But at this point the evidence failed. For whilst the fact of these organisms having been raised from vast depths was too clearly established to admit of the slightest doubt, it is manifest that they might have been drifted from shallow water by oceanic currents, or have lived near the surface of the sea, and gradually subsided to the bottom after death. Accordingly, the mere presence of the gelatinous substance of which their bodies are formed, when taken in connection with the well-known preservative power of sea-water highly charged with saline matter, affords no proof whatever of the creatures having lived in the localities from which they had been conveyed by the sounding-machine. But although the determination of the question as to whether animal life can be sustained at such depths was reserved for a later period, these earlier soundings were not barren of highly important results; for they enabled Professor Ehrenberg, on comparison of the material obtained from the bottom with that entering into the formation of chalk, to announce the extraordinary fact that this rock is built up, atom by atom, of shells similar to those met with in such profusion along the bed of the ocean; and further, that it must have been deposited under conditions similar to those now prevailing; thereby furnishing the clearest proof that the great forces which were in operation at the sea-bed countless ages ago are in operation still; and will, in all probability, continue to be so through all time.

We now arrive at the period when the survey of the sea-bed received a fresh and powerful impulse from the project of establishing communication between Europe and America by means of a telegraphic cable. With a view to ascertain the general contour and composition of the portion of the Atlantic it was proposed to traverse, an expedition was sent by the Government of the United States to sound from shore to shore. But, unfortunately, the information elicited in the course of this survey was so vitiated by inaccuracies as to have induced the eminent officer, then in charge of the hydrographic department at Washington, to pronounce it untrustworthy. A second expedition was accordingly equipped, under the auspices of the British Government. Of the accuracy of the depths recorded on this occasion there could be no doubt. But the intervals between the positions at which soundings were taken were so great, and the means of obtaining specimens of the bottom so imperfect, that, looking at the matter as we now do after the event, it seems impossible to regard the information elicited as in any degree adequate to meet the requirements of the enterprise for which the survey was undertaken.*

It is true these soundings, as far as they went, indicated no extreme alternations of level along the course traversed. But, on the other hand, nothing could be more hazardous than to assume, because a certain degree of uniformity as to depth manifests itself at the isolated spots on which soundings were taken, that a like degree of uniformity must prevail over the wide intervening spaces. Of the spaces themselves we know literally nothing. Nevertheless, on these imperfect premises was it maintained, and by many persons believed, that the entire central tract of the Atlantic, instead of being characterized by variations of level and occasional areas of naked and perhaps rugged rock, such as we might expect to encounter here and there in a region so extended, consists of a level plateau, the entire surface of which is covered by a soft stratum of mud, similar to that indicated by the earlier soundings. Now, it must be obvious to every one that, however steep a submerged declivity may be, unless the depth is ascertained at two or more consecutive points, the information elicited will be the same as if the sounding-machine had been dropped on the most perfect level. And accordingly, for aught these soundings have shown to the contrary, the bed of the Atlantic may present features the most opposite to those that have been ascribed to it. But let us not be misunderstood. It is neither our intention to assert, nor do we believe, that insuperable alternations of level are likely to be encountered. We simply deprecate the hasty adoption of a view so unsubstantiated by proof, and so calculated, if erroneous, to interfere with the accomplishment of one of the most important enterprises of the day.

It should be borne in mind that the supposed plateau does not comprise a limited area, but one extending for upwards of a thousand miles across the basin of the Atlantic. Now, there is no parallel case to this in any portion of the present dry land. And, since there is no ground for the belief that such a vast area could possibly have remained unaffected by the agencies which produce modifications in the earth's crust elsewhere, it is—to say the least of it—extremely improbable that so signal an exception should occur only along that portion of the sea-bed which has been selected as the site of the telegraphic cable. We say *only*, because, judging from soundings taken elsewhere, it is manifest that alternations of level are the rule rather than the exception, and that, in some cases, they are of an important kind.

But it is not necessary to have recourse to soundings in order to prove the accuracy of this opinion. The islands that rise so abruptly in many portions of the Atlantic, if reduced somewhat in elevation, might occur over and over again within the intervals at which the depths have been recorded, and yet be completely overlooked. Their existence is known simply because they are lofty enough to appear above water. It would be an act of rashness, therefore, to assume that formations similar in their character, but of smaller size, do not occur in positions where they still remain unrecognized.

Of what then, it may be asked, does our knowledge regarding the contour and composition of the sea-bed really consist? The answer to this question is by no means unsatisfactory. Thus, it is certain that in no region of the ocean in which soundings have heretofore been attempted with adequate apparatus is the depth so inordinate as to be beyond reach. It is equally certain that, as a general rule, the depths are moderate—that is to say, rarely exceeding 2,500 fathoms, or a trifle under three miles; that, for the most part, the bottom is composed of a soft but tenacious mud, consisting either of an admixture of organic and inorganic *débris*, or of some of these constituents more or less uncombined with the other; and lastly, and pre-eminently perhaps, that deep-seated currents, if they prevail at all, are exceedingly rare and too feeble to produce the slightest deleterious effect upon a submerged tele-

* To render this statement intelligible, it may be mentioned that along 1,300 miles of the Mid-Atlantic telegraph route, only forty-one soundings were taken, the intervals varying between 32 and 71 geographical miles.

graphic cable. These, we venture to say, are no unsatisfactory results when weighed against the limited and imperfect nature of the opportunities that have hitherto been afforded for the exploration of the sea-bed; and so far from being of a disheartening tendency, they offer conclusive evidence that the perfection of our knowledge with regard to the conditions prevailing along any given tract of the sea-bed, falls readily within our powers, and is merely a question of time and perseverance.

(To be continued.)

THE INTERNATIONAL EXHIBITION, 1862.

(*Continued from p.* 27.)

5. *Practical Applications of Electricity other than Telegraphic.*

The *applications* of electricity to the *industrial arts* are not very numerous or important. No illustrations were shown of the *process* of electro-plating, probably the most important of these applications.

Medical apparatus are exhibited by Bellhouse, Pulvermacher, Moreau, and others. The criticism of these instruments can only properly be made by medical men.

Electric clocks are represented by several good examples of old plans, and by two new plans of considerable merit. In the first of these, designed by Mr. Jones, the clock is regulated from a standard clock by the retardation or acceleration of the pendulum produced by the electro-magnetic action on the pendulum of currents received through a coil on the bob at each beat. By this arrangement a temporary interruption of the electric circuit will produce no sensible error, and even a permanent interruption will not stop the clock. The second plan is exhibited by M. Bréguet, of Paris, and consists of a method of putting the secondary clock or clocks in unison with the controlling or regulating clock once every hour, or every six or twelve hours, instead of every pendulum beat. By this plan, among other advantages, the difficulty of obtaining the required contacts from the standard regulating clock without impairing its time-keeping qualities is avoided.

The magneto-electric light is a novelty of great importance, in which steam power is substituted for the voltaic battery, as the generator of the powerful current required. It is probable that this invention will enable the electric light to be extensively used in lighthouses and elsewhere. The electric loom, engraving machine, target, boiler feed, railway break, and printing press, will be described at length in the body of this report, although exhibited in Classes VII. and VIII. Several of these ingenious inventions have such merit as will probably lead to their very general adoption.

Two causes interfere with the extensive adoption of electricity as a mechanical agent. The force, though easily directed, is but small at best; and ordinary workmen are unable to trace out and to remedy defects which may occur in the circuit. Even an unpractised eye will frequently detect what is wrong in mechanical arrangements, but in electric communications a practised electrician will sometimes be puzzled for a while to distinguish the cause of failure. The public is, therefore, probably right in eschewing the use of electricity whenever the required object can be effected by mechanical means.

6. *Concluding Remarks.*

Up to the present day the chief practical service rendered by the science of electricity is the rapid or instantaneous conveyance of intelligence in some form from place to place.

It is somewhat the fashion now to decry the value of the services thus rendered by the electric telegraph. The merchant by its use hardly increases his gains; the soldier resents the interference of which it is made the agent; and the statesman is harassed by the imperfect information it conveys. Even the public complains of receiving the heads of chapters followed by their contents only when their interest is gone. But this reaction rests on narrow grounds.

We may, for argument's sake, disregard the services rendered to governments and generals. The telegraph is an instrument in their opponents' hands as well as in their own—an instrument which, like all others, will be of most advantage to those who have most skill to use it; we may grant that merchants can obtain little news tending exclusively to their own special profit, and that the establishment of rapid communication may even lessen the gains of some by diminishing risks which cannot be borne without large capital; but after granting all this, we have left untouched the main claim to favour, and we may still say that the electric telegraph renders great services to the public at large in the same sense as railways, steamers, and free trade itself may be said to benefit the world. The telegraph is one great agent in the work of compensation, by which the deficiencies of one country are made good from the surplus products of the others. The means of making known a want widely and rapidly are of equal importance with the channels through which the required supply is transmitted. Probably no benefit of equal value is purchased so cheaply by the public.

It is now time to pass to a more detailed consideration of the objects exhibited, and the writer of this report may here say that no one can feel more strongly than he does that the praise or blame of a "Jury" or an "Expert" are very insignificant matters compared with the ultimate award of the public. His aim has been to give such an account of the construction of each instrument as may enable the object of its inventor and the nature of its performance to be understood, pointing out at the same time the apparent merits and defects of each scheme.

It is hoped that the following account will at least form a record of the construction and performance of electrical instruments thought worthy of exhibition and reward in 1862. The various classes of instruments and apparatus will be described in nearly the same general order as that in which they have been mentioned in this introduction. In order to keep within reasonable compass, it has been thought best in general to avoid mention of instruments which are not exhibited.*

† THE CONSTRUCTION OF TELEGRAPHIC LINES.

1. *Successful Submarine Cables.*

The first practical submarine cable was laid by Messrs. R. S. Newall & Co., in the autumn of 1851, from Dover to Calais, a distance of about twenty-seven miles. Specimens of this cable, which is still at work, are exhibited by the Submarine Telegraph Company (United Kingdom, 2,971), and by Mr. Brett (United Kingdom, 2,863), promoter of the company, who also exhibited a specimen in 1851. This cable is made as follows:—

Four copper conducting wires, No. 16, B.W.G. (0·065 in. diameter), covered separately with gutta-percha to No. 2, B.W.G. (0·284 in. diameter), are twisted together with a tarred hemp covering, and the rope thus formed is again served with tarred hemp. This core is covered by ten No. 1 iron wires (0·3 in. diameter) laid helically round it, so as to give the whole the outward appearance of a simple wire rope. The completed cable weighs about six tons to the statute mile.

In subsequent cables, of which many specimens are exhibited, the single copper conducting wires have been sometimes replaced by strands of copper, to avoid the risk of a solution of continuity inside the gutta-percha, and to obtain greater flexibility. The quality of the gutta-percha has been lately much improved, and it has been combined with a varnish known as Chatterton's compound, which possesses some valuable properties. The dimensions of the copper and gutta-percha have been in some cases much increased: sometimes only one insulated conductor, and sometimes as many as six have been used. Sometimes large wires, and sometimes smaller

* The names of exhibitors who have received medals will, in the following report, be marked with the letter M. at the beginning of the description of each object exhibited by them. Those who have received honourable mention will be similarly marked by the letters H. M. The writer has adopted this plan after much consideration, for the following reasons:—The wording of the awards, necessarily short, by no means expresses fully or exactly the merit of each exhibitor. The award occasionally mentions only general excellence, and occasionally special instruments with approval. If the reward were mentioned in connection with every instrument where general excellence is rewarded, and only in connection with the one instrument where special excellence is attributed, injustice would frequently be done. Still greater injustice would result from the omission of the award from all instruments where general excellence is conceded. The wording of the award can, moreover, be consulted at pleasure, when the reader wishes to know whether any given instrument has been specially mentioned.

† 6, Duke-street, Adelphi, W.C., Oct. 7, 1863.

Sir,—Will you allow me to correct an error in my Report to the jurors on Electrical Instruments. In page 49 it is said that the first practical submarine cable was *laid* by Messrs. R. S. Newall & Co. I should have said that it was in chief part manufactured by Messrs. R. S. Newall, after some portion of the work had been done by Messrs. Wilkins & Weatherly, but that it was laid by Mr. Crampton, assisted by Mr. Wollaston.

You might place this letter as a foot-note in large type at the proper place in the reprint with which you are honouring the Report.

Your obedient servant,

Fleeming Jenkin.

ones have formed the outer protection; these wires have been sometimes separately covered with hemp to lighten the cable, or conjointly covered with hemp and bitumen as a protection against rust; in fine, many slight alterations have been proposed and adopted, but nevertheless, the cable laid in the present year for the Electric and International Company between England and Holland is in all essentials the same as that first laid between Dover and Calais. So far as shallow water cables are concerned this type promises to remain as constant, and, it may be added, as successful, as that of our railways, adopted by George Stephenson.

The Submarine Electric Telegraph Company (United Kingdom, 2,971) now own five cables, the aggregate length of which is 835 miles, and these cables contain 2,575 miles of insulated wire. They exhibit specimens of each cable. The first has been already described. The second, laid by Messrs. R. S. Newall & Co. in 1853, between Dover and Ostend, is 80½ miles long. It has six insulated conductors similar to those of the first-named cable, and is covered with twelve No. 2 iron wires. The third and fourth cables, connecting England with Denmark, and England with Hanover, were laid by Messrs. Glass, Elliot, & Co., and their length and dimensions will be found in a subsequent table, C; finally, the Beachy Head and Dieppe cable, 80 miles long, has six conductors formed of No. 16 copper wire covered to No. 1 gauge, and protected by twelve No. 1 iron wires. This cable was made in 1854 for a line between Sardinia and Algiers; part of it was lost in an unsuccessful attempt to carry out the line, and the remainder was laid by Mr. W. T. Henley in 1861 across the Channel.

Glass, Elliot, & Co., M. (United Kingdom, 2,900), show a large case filled with specimens of cables successfully laid by them in deep and shallow water. Altogether these specimens represent nearly 4,000 miles of cable, containing more than 6,700 miles of insulated wire, all successfully laid, and, with very insignificant exceptions, all now at work. A list of these cables is given in the following Table.

Table A.—List of all the Submarine Telegraph Cables Manufactured and Laid Down by Glass, Elliot, & Co., London.—October, 1862.

Date when laid.	From	To	Number of Conductors.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Period of Working.
1854	Sweden	Denmark	3	12	36	8 years.
1854	Italy	Corsica	6	110	660	8 years (deep sea).
1854	Corsica	Sardinia	6	10	60	8 years.
1855	Egypt	— — —	4	10	40	7 years.
1855	Italy	Sicily	1	5	5	7 years.
1856	Newfoundland	Cape Breton	1	85	85	6 years (deep sea).
1856	Prince Edward's Island	New Brunswick	1	12	12	6 years.
1857	Norway across	Fiords	1	49	49	5 years (deep sea).
1857	Across mouths of	Danube	1	3	3	5 years.
1857	Ceylon	Mainland of India	1	30	30	5 years.
1858	Italy	Sicily	1	8	8	4 years.
1858	England	Holland	4	140	560	4 years.
1858	Ditto	Hanover	2	280	560	4 years.
1858	Norway across	Fiords	1	16	16	4 years (deep sea).
1859	Alexandria	— — —	4	2	8	3 years.
1859	England	Denmark	3	368	1,104	3 years.
1859	Sweden	Gottland	1	64	64	3 years.
1859	Folkestone	Boulogne	6	24	144	3 years.
1859	Liverpool	Holyhead	2	25	50	3 years (out of working order).
1859	Across rivers	in India	1	10	10	3 years.
1859	Malta	Sicily	1	60	60	3 years.
1859	England	Isle of Man	1	36	36	3 years (out of working order).
1859	Jersey	Pirou, in France	1	21	21	2½ years.
1860	France*	Algiers	1	520	520	2 years (deep sea).
1860	Corfu †	Otranto	1	90	90	2 years (deep sea).
1861	Norway across	Fiords	1	16	16	1½ year (deep sea).
1861	Toulon	Corsica	1	195	195	1½ year (deep sea).
1861	Malta	Alexandria	1	1,535	1,535	1 year (80 knots, deep sea, 1,150 knots shallow).
1862	Abermawr, Pembroke	Grenore, Weyford	4	63	252	16 months.
1862	England	Holland	4	130	520	2 months.
				3,929	6,749	
		Deduct broken		61	86	
				3,868	6,663	

They are all of the usual type, except the France-Algiers* and Toulon-Corsica cables. These deep-sea cables were covered with steel wires, each of which had a serving of hemp applied with such a lay as materially to strengthen as well as lighten the cable.

This form would deserve a much fuller description than is here given, were it not for the fact that it probably will not again be used, in consequence of the attacks made by a species of teredo on the hemp. Messrs. Glass, Elliot, & Co. also state that it was found liable to kink.

The teredo consumes the hemp with great rapidity, leaving a mere bundle of loose wires round the core, which cannot then be lifted for repairs. These animals have also attacked the gutta-percha, and although hitherto they have not been known to make any very deep impression on it, their presence is certainly to be avoided as one source of danger. They are found at all depths, but have never been known to lodge in hemp under the usual iron covering; a few inches of loose hemp is sufficient to determine their presence in some seas.

The iron wires of the Isle of Man cable, and of the Wexford cable, are protected against corrosion by a compound of bitumen and hemp patented by Mr. Latimer Clark. This protection is fast coming into favour. The Malta-Alexandria cable, laid lately under the superintendence of Messrs. Gisborne & Forde for the English Government, is remarkable for its great length, the large dimensions of the insulated wire, and the perfect success with which it has worked since its submergence.

* In laying this cable it became necessary on two occasions to recover or pick up in the deepest water several miles of cable which had been submerged. On one occasion, when about thirty miles off Cape St. Sebastian, in a depth of 1,250 fathoms, and very rocky bottom, sixteen miles of cable were recovered, a fault cut out, and the cable relaid with perfect success. It has failed (temporarily at least) since writing the above.

† The end of this cable was lost in 450 fathoms off the Island of Fano, near Corfu. It was grappled for and recovered, and the line completed.

(To be continued.)

THE CONSTRUCTION OF TELEGRAPH LINES.

As, in consequence of the publication of Mr. Culley's book, considerable attention is being called to questions of construction and insulation, it may not be uninteresting to show what changes have actually taken place, or are impending in these respects.

The United Kingdom Telegraph Company have erected great lengths of line within the last three years, and there are some specialities in their mode of construction which appear noteworthy, and seem calculated to be beneficial in their operation. Thus, about three years ago, on the recommendation of Mr. Andrews, the manager of the company, the system originally in use of earth wiring, was changed:— Instead of carrying wires direct from the bolts of the insulators to the earth, which must greatly diminish the resistance, wherever there is loss or defective insulators, and necessarily create a maximum loss, the earth wire is bound three times round the arm, near the pole; any escape from the insulator is intercepted on reaching this point, and prevented from passing to other wires to make contact, and thus, as in the former system of earth wiring, only loss has to be overcome, and this is far less troublesome than what is technically known as weather contact. This loss or escape, too, is left at its natural figure, and not unnecessarily augmented, as is the case when the earth wire is taken directly to the bolt. Great care is also taken with the arrangement of the earth wires on the poles, to secure a good conducting surface, for what may not inaptly be termed "the intercepting system."

The company also early discovered that, to secure good and reliable working, the wires must be kept long distances apart, and for the last two years and upwards, the company has been carefully carrying out this policy, wisely, we think. The vertical distance, for instance, between the arms, is 10 and 12 inches, and the horizontal distance, from centre to centre of the insulators, from 22 inches up to 28 inches. Hence the probability of metallic contact, between the wires, is reduced to a minimum, and more work is thus got out of a small number of wires, than there would otherwise be obtained out of a large number erected upon the old plan.

These are practical points of interest to those engaged in constructing or carrying out telegraph lines, and we are not aware that these changes have been earlier carried out by any other company.

THE NEW TELEGRAPH.

The practice of the electric telegraph has been so successful that the public have almost lost any regard for the theory upon which it is based, and content themselves with the knowledge that they can for a shilling send twenty words from Liverpool to London; and the feeling of congratulation with which the discovery was welcomed has now become obliterated by one of unreasonable expectation, the only consideration being that each individual must have his message transmitted at once and delivered immediately. The public neither know nor care more than that a current of electricity passes from here to there, and makes some intelligible signs.

A rapid succession of beautiful inventions, each of which presented some new feature, has palled the appetite for wonders: and after seeing the latest improvement in type-printing telegraphs, nothing more seems required, and curiosity has gone to sleep. There is, however, now in Liverpool, and in operation at the Electric Telegraph Company's Offices in Castle-street, an instrument which, from its ingenuity of construction and perfection of results, deserves most careful attention. The object is to transmit autograph messages in the exact form in which they are written; and the most complicated figures, designs, sketches, or indeed anything that can be drawn by an ordinary pen, is transmitted as readily as the simplest dot or stroke. The instrument may be described as consisting chiefly of an iron frame, resembling the letter A, within which a heavy pendulum vibrates. About half way up one side of the frame an axle is placed transversely, and connected by an arm below and a rod to the pendulum, so that every vibration of the pendulum rocks this axle to and fro for about one-third of a circle. On the upper side of the axle, and at each end of it an arm is affixed, carrying a bent pointer or tracer, which runs over and in contact with a brass plate, curved to suit the radius of the arm. The message or sketch to be transmitted having been written upon foil paper with an ordinary pen, it is placed upon one of these tables, a piece of prepared paper being similarly placed upon the distant instrument intended to receive the message, the pendulum is set in motion, and the pointer makes a traverse across the plate of foil upon which the message is written. At all the points of contact with the metal a current of electricity continues to pass through the instrument; but where the ink intervenes the current is broken, and a corresponding interruption takes place on the distant machine by means of a rack pinion and screw, all worked by the pendulum. The pointer traverses over the whole plate in twenty minutes, and in that time would transmit as many words as could be written upon half a sheet of letter paper. The smaller the writing, therefore, the better.

At the return stroke of the pendulum the pointer on the second table comes into operation; thus two messages are transmitted at the same time by alternate vibrations, and at the turn of each stroke the pendulum bob comes in contact with a magnet, which maintains its motion, and communicates a similar one to the distant pendulum, thus correcting the isochronism and ensuring coincidence in the figure transmitted.

The principle of transmitting written messages is not new; but former inventors used a barrel driven by clockwork as the table for the paper, and although perfect results similar to these could be obtained, the liability to error in the rate of two clocks, and the difficulty of getting an apparatus sufficiently delicate to repeat currents rapidly, has prevented their economical use.

The most beautiful parts of this instrument are the relay coils and the automatic connections, which overcome these great difficulties so well, that the pointer may pass over a dozen or twenty words in a second, and the breaking and closing of the circuit will be complete for every letter. The influence of such improvements as these upon the commercial world are great, and may be judged from the fact that, in the London office of the Electric Telegraph Company alone, there are a dozen machines and operators for Liverpool work only.

If a company can, by rapid instruments, use one wire instead of two, one servant instead of two, and save transcribing in addition, the public will soon find the advantages of such inventions as these, which we concientiously believe to be destined to supplant the slow and unintelligible dot and stroke.

The only difficulties remaining to be overcome, so far as we can see, are—the great one of people writing their own messages so that they can be read, and the risk of the extremely delicate relay apparatus in its rapid vibrations being effected by atmospheric electricity.

We cannot say if this is fully achieved by Mr. Casselli; but we presume it is, for the apparatus has worked in Paris for ten years, and is, beyond doubt, the nearest approach to a perfect telegraph that we have seen.—*Railway News.*

COLONIAL TELEGRAPHY.

A very interesting report has just been published, giving an account of the electric telegraphs in Australia. In his financial speech Mr. Smart quoted one passage from this report to show the encouraging financial prospects of this investment. The telegraph is one of the few Government speculations which pay, and its success is an illustration of the over caution which capital sometimes displays in venturing on new enterprises. To have connected Melbourne and Sydney was a very proper enterprise for a private company. Yet capitalists would not look at it. Government was obliged to take it in hand, and when completed it was found to be very remunerative. The rapid multiplication of branch lines reduced the original dividend, but now it is beginning to rise again under the influence of the large trade that they create. For the last three years there has been a steadily increasing return. In 1860 the net revenue was at the rate of 5⅝ per cent. per annum on a capital of £48,500. In 1861 the net profit was at the rate of 6 per cent. on an invested capital of £60,000. In 1862 the net profit was at the rate of 7¾ per cent. on an invested capital of £116,235. This latter sum includes a charge of over £12,000 for building stations. This is a very satisfactory result, and is an encouragement to proceed with the extension of branch lines. That the telegraph makes business for itself seems proved by the fact that the branch lines pay better after the first year, when people have got accustomed to using them. It would be possible, of course, to overdo these extensions in a financial sense, but the Government is taking precautions against that by asking a guarantee of 5 per cent. interest from the residents in those districts that desire to have the telegraph. The cost of the telegraph is so slight compared with the convenience, that this guarantee is not onerous. The contract price for constructing new lines ranges from £38 to £50 a mile. The cheapest line was that from Campbelltown to Kiama *viâ* Wollongong. The total length of telegraph now in use is

2,174 miles, and, as for some distance there is a double wire, the length of wire is 2,539 miles. We have not only more extent of telegraph than any of the neighbouring colonies, but ours is the only colony in which it is a paying investment. Mr. Cracknell refers to the proposal which has been made to reduce the charges, but deprecates it as certain to lead to a loss of revenue, and argues that the public will be better accommodated by an extension of the lines than by a diminution in the charges.

Besides asking a private guarantee for rural extensions, the Government now offer to construct private lines to coal mines, or other large establishments, and work these lines at a charge of 5 per cent. on the outlay added to the cost of messages sent over the public line. At Bellambi this plan has been accepted, and it is expected that the Newcastle companies will also avail themselves of it.

The telegraphic money-order system did not pay, at which we are not surprised; the convenience was great to those who used it, but the occasions for its use were not likely to be very frequent. It is comparatively seldom that the payment of money is so urgent as not to wait the post. The telegraph, however, can still be used to secure the prompt payment of an ordinary postal money-order, if the sender thinks proper to go to the expense of sending the necessary message.

Wind and weather reports are daily received by telegraph from eight meteorological stations in the colony. Mr. Cracknell suggests that the number of these stations should be increased; and, furthermore, he suggests the adoption of the English plan of hoisting warning signals along the coast indicating the direction of coming gales. This, of course, would add to the expense of the department, without bringing in any income, but it might be the means of saving many lives, and much property.

Adverting to the Indo-Australian telegraph, Mr. Cracknell suggests that the colonies should jointly guarantee the funds for assisting Queensland to carry the line to the Gulf of Carpentaria. Since the date of his report, however, the Queensland Government has superseded this proposal by boldly proposing to undertake the whole work on its own account. The sum of £180,000 has been placed on the Estimates for that purpose, the design being to coast northwards as far as Port Denison, and there to strike across to the Gulf. The Parliament has not yet assented to this estimate. It is a bold undertaking for so young a colony, but there can be no doubt that it will prove indirectly, if not directly, remunerative. It would certainly precipitate the colonisation of Northern Australia. The only doubt we have as to the policy of the Queensland Government relates to the route chosen. Instead of clinging to the coast for so far northward as Port Denison, it would seem a more likely course to facilitate the occupation of the interior if the line struck inland through the fine pastoral territory now known to exist. In the course of a few years, however, there will probably be lines by both routes.

We have heard but little lately of the progress of the Anglo-Indian telegraph, but the preparatory work is going steadily forward, and before very long we may be startled by hearing that Calcutta is in regular communication with London, and by finding that our mail steamers, on leaving Galle, can bring away with them English news only three days old. The popular impression of the feasibility of connecting London with Sydney will then be quickened. But those who can forecast events can already see that it is by no means too soon for Australia to be preparing itself. The Queensland Government is not premature in the proposal it is making. Two or three years will probably be required for the accomplishment of the work, and by the time it is finished the junction with Batavia might, with proper arrangements, be contemporaneously completed. It has been suggested that a telegraphic communication between Sydney and Asia, north of the line, would greatly assist the development of our coal fields, and be an advantage to us independently of the benefit of being connected with Europe. There is very little doubt that this would be the case, especially if the projected line from Singapore to China is carried out.

LAW INTELLIGENCE.

THE SUBMARINE TELEGRAPH COMPANY *v.* DICKSON.—This was an action brought by the plaintiffs against the defendant, the owner of a Swedish ship, for so negligently casting his anchor when in the Channel, off the Kentish coast, that he caught, got entangled with, and damaged the plaintiffs' cable. The defendant, in substance, pleaded that he was lawfully navigating his ship, more than three miles from the coast, and that he had no notice that the cable was where he cast anchor. The plaintiffs now assigned that the defendant so negligently disentangled his anchor from the cable when he knew it was there, that he damaged it. There was another replication that the soil was the Queen's, who had given him licence to lay the cable there, in answer to a plea averring that the accident happened on the high seas, where the Queen had no jurisdiction, the ship being a Swedish ship. Both declarations and pleas were demurred to. Mr. R. Clark appeared in support of the declaration, and argued for the plaintiffs, and Mr. Archibald for the defendant. The Chief Justice thought the declaration good which charged damage to the plaintiffs by the negligence of the defendant. He assumed that the bottom of the sea might be used for lawful purposes as well as the surface. Of that the Court might take judicial notice, there being Acts of Parliament on the subject of submarine cables. The plaintiffs had a right to use the bottom of the sea, and to place their cable there. The defendant had a right to use the surface of the sea for the ordinary purposes of navigation, and to let go his anchor if the need of navigation required it. The two rights happened to conflict; the plaintiffs' property was damaged and their right violated by the defendant breaking their cable with his anchor. The defendant said, "I have a right to let go my anchor." Then came the replication, "You might have had that right, provided you had exercised it with due care and skill; but you had no right at all to damage our property." The whole essence of the case turned on the word "negligence." "If you had used due skill and care the damage would not have arisen." Mr. Justice Williams concurred. Mr. Justice Willes said, the defendant was bound to use reasonable care in so dropping his anchor as not to foul the cable. The declaration was good, the plea good, the second replication good, the third replication bad, as traversing immaterial matter.—Judgment for the plaintiffs.

CORRESPONDENCE.

MR. ANDREWS' PNEUMATIC APPARATUS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I must confess my extreme surprise and pain to see in your journal of this day a statement by Mr. France, the present acting-engineer of the Submarine Telegraph Company, that he furnished the plan for my Pneumatic Apparatus described in the first number of your journal, and that I had the instrument manufactured on his plan without modification, I being the then engineer to the Company, and that not the slightest alteration was ever made in his original suggestion.

I am compelled to give to this statement the most unqualified and the most direct contradiction.

The idea of the Pneumatic Apparatus, with numerous other means of effecting the same object, namely, an instantaneous descending movement without resistance, combined with a graduated ascending movement, with the necessary "breaks" and "makes" of connection by one piece of mechanism, for submarine telegraphic purposes, originated solely with me.

A Mr. Banks, who was at the time mechanician to the Submarine Company, had the most to do with carrying out my plans in constructing this and other apparatus, which I mooted before I engaged Mr. France; the latter simply at one period conveyed my instructions to the manufacturer, and did not make one single suggestion of any kind whatever in relation to the construction of this or any of my apparatus.

I, of course, only claim my own forms; there are other instruments for effecting the same objects—those, namely, of Mr. C. F. Varley, and of Messrs. Siemens.—I am, Sir, your obedient servant,

W. ANDREWS,
Late Engineer to the Submarine Telegraph Company.

Melbourne Cottage, North Brixton,
London, 20th Jan., 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have seen a letter signed by J. R. France, and stating that he is the inventor of the Pneumatic Adjustment for working submarine cables. I was mechanician to the Submarine Telegraph Company at the time these pneumatic instruments were suggested, and the suggestion and the entire working out of them was proposed by Mr. Andrews, the former engineer to the Submarine Telegraph Company, before Mr. France returned from the Mediterranean and was engaged by the Company.

The instrument was solely Mr. Andrews', the then engineer, who gave all the instructions, and Mr. France had nothing to do with originating the instrument, and made no suggestions at all about them, and I can answer for it that Mr. Andrews was alone the inventor.

The manufacturers, who were always to and fro with Mr. Andrews and myself, would, I am sure, bear this out.

This was one of three or four instruments to do the same thing which Mr. Andrews at the time invented.—I am Sir, your obedient servant,

St. John's Wood, Jan. 19th, 1864. JAMES BANKS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have seen a letter in the *Telegraphic Journal* about Mr. Andrews' Pneumatic Arrangements; these were first talked of before Mr. France joined the Submarine, and all my negotiations about them were with Mr. Andrews, who explained the principle and gave all instructions about them; they were a long time in hand, with other apparatus designed by Mr. Andrews, who was trying several at the time, and in all these cases, including the pneumatic, Mr. Andrews it was who originated and carried them all out.

Mr. France saw me afterwards about making the Relay Pneumatic Arrangement; also for the key, acting, as I understood, under Mr. Andrews' instructions; but the instrument was no doubt designed and invented by the late engineer to the Submarine Telegraph Company, Mr. Andrews.

I am, Sir, your obedient servant,

GEORGE GUY,
Manager to the Manufacturer.

39, Windsor Terrace,
London, 19th Jan., 1864.

THE BONELLI'S TYPO-ELECTRIC TELEGRAPH.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Grateful as I am to your correspondent for the very complimentary way in which, as people in post-prandial orations say, he has mentioned my name, I feel that the public has so little interest in the exchange of epistolatory amenities, that I shall, without apology, address myself to that portion of "J. P.'s" letter which demands an answer.

It happens curiously enough that the point which "J. P." considers the weakest in the Bonelli system is precisely that which I esteem the strongest, and I venture to think by the aid of a few plain figures I can prove that I am right.

The impression conveyed by your correspondent's letter would be that the telegraphic transmission (warm from the lips of fervid eloquence) of the words (upon which a nation hangs) is effected without pause or intermediations; that the manipulator of the instrument catches the inspired sentences as they fall, and flashes them with kindred fire and rival rapidity along the wire. Alas, the case is far otherwise—much more prosaic and laborious. It is, as I understand the matter, thus:

An accomplished stenographer takes his place, the orator opens his lips, and fast as the honied or embittered words, the learned aphorisms or the logical deductions fall, they are written down in those marvellous, and, to the mass, incomprehensible symbols which constitute "short-hand." To the writer, and to the writer only, these notes are as an open book, and, consequently, at the expiration of a given time—some half-hour or twenty minutes—this gentleman gives place to another reporter, and while the matter is fresh and vivid in his mind, reproduces, by a combined effort of memory and imagination, the speech of the orator, and transcribes these calabastics into characters which are potent to the vulgar eye. Up to this point all systems are in abeyance. The transcription is handed as fast as it can be written to the Morse clerks or Bonelli type-setters; starting, therefore, as we do, fairly from this point, let us compare the two systems with each other.

For this purpose I propose to take two instances which have been much insisted on as evidences of the rapidity of Morse signalling: the recent speeches of the Emperor of the French, containing respectively 2,044 and 1,316 words, were transmitted from Paris to London, the former in an hour and a quarter, the latter in twenty minutes; in the one case two wires were employed, in the other four, thus giving an average seven words per minute for each clerk employed. These 3,360 words were transmitted in one hour and thirty-five minutes; an equal number of compositors could set this number of words in type in thirty-seven minutes—ten minutes more would suffice to transmit the whole clearly printed in permanent plain Roman characters, making a total of forty-seven minutes; showing a clear gain of forty-eight minutes, not to mention the important fact that in the one case no translation or transcription, with all the consequent liability to error is required, while in the other, every word must be reduced first from written to conventional signs, and then from conventional to ordinary characters before it reaches the hands of the printers. It happens, however, that the speech of the Emperor, and all similar discourses, are handed beforehand to those interested; and thus, although it is not etiquette to commence transmission before the last word has died upon the lips of the speaker, the type might of course, without breach of propriety, be set up, in this case it being unnecessary to use a permanent solution; three minutes later the entire speech, punctuated and perfect, in the form most easy for recomposition, would be in the hands of the type-setters in Printing-house-square. "J. P." appears to forget that with an instrument capable of transmitting, by the aid of a couple of boys, 72,000 words per hour, the whole staff of the company—or, rather, of an office—would be available; or, to meet some special emergency, a dozen extra type-setters could be called in, so as to reduce the time to an almost indefinite extent.

With the Bonelli system the sole limit to rapidity is imposed by the time occupied in translating and writing out the short-hand notes. Let the reporter be replaced every ten minutes, and let it occupy him twenty minutes to transcribe his ten minutes' work, there is no earthly reason why the longest speech should not be in print in Manchester or any other place thirty minutes after an orator in London ceased to speak; and as the same type would of course serve for any number of transmissions, the whole would be delivered in every city to which the system is extended three seconds later in each succeeding case. I feel these few remarks will suffice.

I smile at "J. P.'s" idea that these marvels can be accomplished with one wire. All single wire instruments must be either synchronous or slow, such at least is my rooted conviction; and I have so often thought on the question till my head ached, that I have determined to consider the question at rest till I see some proof that I am wrong.

Kind friends are continually assuring me that the great electrical authorities of England persist in ignoring the merits of Bonelli's instrument, saying (that there is nothing in it) that it will not answer, &c. I would be so grateful if some of those gentlemen would leave such weak generalities and tell me and the world they guide upon what possible grounds they base their assertions.—I am, Sir, obediently your servant,

7, Angel-court, City. HENRY COOK.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Your correspondent, "J. P.," in the last number of your journal, seems to have an imperfect knowledge of the transmitting powers of the *Morse* instrument. The transmission through that instrument scarcely ever exceeds 25 words per minute, and the words, being formed of *dots* and *dashes*, must be transcribed into common handwriting before the matter can be placed in the printer's hands, which occupies considerable time. While with the Bonelli typo-telegraph the reporter at the House of Commons, or at any public meeting, delivers his copy into the hands of some dozen or more expert compositors, whose galleys are *combed over*, as it were, as rapidly as they can be placed in the telegraphic machine, the matter appearing at the distant end *printed*, and is transferred at once into the hands of the printers at the newspaper-office. The strips may be divided among any number of printers as occasion may require; and, as the instrument is capable of transmitting words at the rate of 72,000 per hour, I see no reason why we should not have the words warm from the "fervid lips of eloquence" as soon as the wires are carried down south.

Yours obediently,

Manchester. A MORSE MANIPULATOR.

RESISTANCE COILS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Mr. Fleeming Jenkin, in his report of the jurors' decisions in Class XII., which appeared in your last number, states that no resistance coils were exhibited in 1851—meaning, I presume, the International Exhibition which took place that year—but that "Professor Wheatstone's rheostat and resistance coils had been described in the *Philosophical Transactions* as early as 1843." I have had opportunities of making several experiments, in the carrying out of which I employed the identical instruments above referred to with far greater success than with any instrument of modern construction; but what I am anxious to know is, when was the system of measurement by resistance coils first introduced, and by whom, into practical telegraphy? The resistance coils are now extensively employed by electricians in every part of the globe; but I have heard the merit of their first introduction attributed to so many individuals that I am desirous to learn to whom the honour is really due. Yours, &c.,

A SUBSCRIBER.

TELEGRAPH EMPLOYÉS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your first number you promised to devote a portion of your space every week for the benefit or instruction of the student and amateur. I noticed also in the same number a letter signed "J. R. O.," referring to the notion which seems somewhat prevalent, that telegraph clerks, as a rule, are but an ignorant, ill-informed class in the matter of telegraphic and electrical knowledge. I know not if it be true that we are so far below the status of continental clerks in this respect; but I *do* know that a great many of those in the service of our large telegraph companies have no means of acquiring such knowledge save that afforded them by the pages of a cheap, popular serial like the *Telegraphic Journal*. The simplest and rudest apparatus for the conducting of electrical experiments costs more money than most ordinary clerks can afford, who enter upon that vocation as a means of earning a livelihood, and there are scores of these individuals who remain in the service for years without materially bettering their circumstances; they form connections for life, and little ones rise up depending upon their not over-abundant earnings for support; and this is the tendency of mankind in all circumstances, prosperous or otherwise, however Malthusians may rate; and hence these otherwise very deserving individuals are literally debarred from making any extraordinary advance in the knowledge of the glorious science of which they are, so to speak, the humble exponents. I well remember a case in point some six or seven years since when I had occasion to reside in a not very large town in the Midland Counties. It boasted of but one telegraph station, the duties of which were performed by one clerk, whose salary amounted to but a trifle over 20*s.* per week. Out of this he had a family of three children to provide for, and a faithful spouse, who, I'll warrant, would not stop short of a dozen such blessings. I never witnessed that worthy individual striving to look respectable in a threadbare coat, for which no tailor ever took his dimensions, and his shoes polished like a nobleman's, although sadly down at heel, decorously taking his Sunday afternoon's walk, carrying the baby, while Materfamilias and the two little Dames Trot trudged along by his side, but what I always experienced a mingled feeling of pity and admiration.

The ancient philosopher tells us that an honest man struggling with adversity, and withstanding the temptations incident to the situation, is a spectacle which excites the admiration of the gods, and upon which they look down with peculiar favour. But, alas! if the gods should do no more than this for a telegraph clerk who is poor, and yet too honest to mend his circumstances by other than the strictest rules of rectitude, he will make little attainments in electrical science this side the Olympian Mount.

A man with limited means may make vast strides in self-culture in any department of science, art, or mechanics, as long as he remains single; but let him once pay his devotions at the shrine of Hymen, and there is pretty sure to be an end of it, unless the goddess of prosperity makes her advent at the same time.

Now, it is quite certain that every clerk in the service cannot reasonably expect to be the recipient of a windfall; hence the majority must ever remain at best but just respectable citizens, who, when they have paid their way on Saturday night, have little left for extras, and nothing for superfluities. How is this important class to progress in knowledge and attainments of a science of which it is impossible to acquire any practical information without considerable expense? And how is the stigma to be removed, whether just or unjust, under which they lie? For myself, I believe it to be a cruel and unjust aspersion. I would ask, in what country in Europe is the work of a telegraph company more efficiently performed than it is in those lines worked by English clerks? And surely this should be esteemed proof positive that such an assertion is unjust and utterly destitute of foundation. Nevertheless, every one must admit there is room for improvement. Telegraph clerks cannot know too much of the mysteries of the science; and a thorough acquaintance with the numerous and diverse instruments used in its development is no less indispensable. We look to you, sir, therefore, to render us that step by step information which shall bring us up to the same point of electrical and telegraphic attainments as that which characterizes the first electricians of the day; and then if we fail to profit by the same, and do not excel our former selves and our bearded cousins of Gaul and Vaterland, may we suffer the full measure of just reproach, and be stigmatized as unworthy the vocation which we ought to adorn. I have been expecting your first instalment for students and amateurs, and so, I know, have many others. Pray do what you can to render necessary information in a popular and understandable form. Let us have descriptions of instruments, and so forth, which have made their inventors famous, but of which, alas! we know nothing; and every other description of knowledge which it is essential we should know.

A CITY TELEGRAPH CLERK.

TELEGRAPHIC NEWS.

THE Electric and International Telegraph Company are constructing an additional pneumatic apparatus between their chief station in Telegraph-street and the branch establishment in Leadenhall-street. The pipe is 2½ inches in diameter, and we believe that considerable improvements have been recently effected in the method of working the pneumatic pipes now being laid.

DURING the last year the construction of the telegraph for military services in the United States has been very greatly extended. There is now in operation and connected with the military department not less than 5,326 miles of telegraph; of these, 1,755 miles of land and submarine lines were constructed last year. The Secretary of War reports that not less than 1,200,000 telegrams, on an average 3,300 per day, have been sent over these lines. The messages so sent varied from 10 to 1,000 words, and were for the most part of an urgent or most important character.

THE progress of the Electric Telegraph in Russia during the last few years has far exceeded that of any other country, especially when we consider the enormous difficulties the contractors and engineers have had to contend against in constructing their lines over hundreds of miles of inhospitable and barren steppes, and across regions inhabited by people in a state of semi-barbarism, where the poles and wires are protected by having the sacred cross suspended to the wires or affixed to the poles. Lines from St. Petersburg and Moscow now penetrate into the penal solitudes of Siberia, and have reached the frontiers of China, and are rapidly progressing towards the Amour, along the banks of which they will extend to join the proposed submarine line, uniting through Russian America, St. Petersburg, and New York by means of the San Francisco telegraph. Several contracts have been recently entered into by English houses for the construction of lines in the interior of Russia, amongst whom we may mention Messrs. Siemens, Halske, & Co., and Messrs. W. M. Warden, & Co., of Westminster, the latter firm having, we understand, entered into an arrangement for the construction of a double line of telegraph on the Dünaborg and Vitebsk Railway—a distance of 160 miles.

BY the latest intelligence from North-West British America we are pleased to learn that Professor Hind was to have read a paper on the commercial resources of the Lake Winnipeg and Saskatchewan districts in Central British America, at the rooms of the Statistical Society, on Tuesday, the 19th instant. Professor Hind had just arrived from Canada, and placed before his auditory the latest intelligence respecting the territory he explored, under instructions from the Canadian Government, in 1857 and 1858. The recent reorganisation of the Hudson's Bay Company would give prominence to any additional information that can be made known regarding North-West British America. Recent events in the State of Minnesota, whose northern boundary is conterminous with the Lake Winnipeg and Saskatchewan districts, render any information bearing upon commercial progress there peculiarly opportune at the present juncture. Our readers are familiar with the splendid schemes for colonization and telegraphic communication recently put forth in the prospectus of the Hudson's Bay Company, but it is not generally known that important steps have already been taken by the citizens of Minnesota to secure to themselves the rapidly developing commerce of the "Great North-West." From all we can learn on the subject, the construction of the proposed telegraph across the continent through British America, under the auspices of the Hudson's Bay Company, can be accomplished without difficulty, as well as a postal communication by the route of the Canadian emigrants of 1862 from Canada to British Columbia. The more we know of the vast resources of this part of Central America the wider appears to be the field for commercial enterprise. So rapid is the progress of the settlement on the American continent that all the farm lots on the immediate bank of River Kaminishquia, at the head of Lake Superior, only lately brought into the market by the Canadian Government, are taken up by actual settlers, and where, at the utmost westerly limits of Canada half-a-dozen years ago, the forts of the Hudson's Bay Company and an Indian village afforded the only signs of civilization, there are now to be found hundreds of settlers clearing and cultivating the land and bringing the mineral wealth of that region into the market. Further North-West, in the valley of the Red River of the North, American settlers are flocking into British territory, tempted, no doubt, not only by the excellent quality of the soil, but by the prospective circulation of money which the construction of the telegraph and the opening of a postal route must ensure. After many years' delay we now begin to discern signs of activity on the part of those who have the interests of that vast region for a time in their hands. We say for a time, as it is certain that if energetic measures are not taken the course of events will be such as to bring about, under other auspices, the opening of the North-West, which has been too long delayed already. The title of the paper which Professor Hind is to bring before the Statistical Society leads us to hope that he will furnish such a view of the resources of Central British America as will not fail to direct public attention to that long-neglected country. Telegraphic and postal communication, under British control, between the Atlantic and Pacific, is a grand conception; but if it can be shown that the country possesses natural resources to sustain a line of agricultural settlements from sea to sea, the scheme then becomes one of national importance. We look forward with much interest to the delivery of the paper.

MISCELLANEA.

THE velocity of electricity is so great that the most rapid motion which can be produced by art appears to be actual rest when compared with it. A wheel revolving with celerity sufficient to render its spokes invisible, when illuminated by a flash of lightning, is seen for an instant with all its spokes distinct as if it were in a state of absolute rest. This beautiful experiment is due to Professor Wheatsone, as well as the following variation of it, which is not less striking. Since a sunbeam consists of a mixture of blue, yellow, and red light, if a circular piece of pasteboard be divided into three sectors, one of which is painted blue, another yellow, and the third red, it will appear to be white when revolving quickly, because of the rapidity in which the impression of the colours succeed each other on the retina. But the instant it is illuminated by an electric spark it seems to stand still, and its colour is as distinct as if it were at rest.

SOME attention has been directed to the enormous variation in electric conducting power, caused by the admixture of even minute quantities of metallic or other impurities in copper. It has become a question of some interest to determine the electric conducting power of all the pure metals. Professor Matthiessen has continued his researches on this subject, and has lately determined the electrical relations of pure thallium. At the freezing point of water this metal has a conducting power equal to 9·16 (pure silver being 100), and its conducting power decreases between the freezing and the boiling point 31·420 per cent., which is a larger percentage decrement than that obtained for many other pure metals—namely, 29·307 per cent. The conducting power of pure iron was found to be at 0° C = 16·81, with a percentage decrement for an increase of temperature to 100° C = 38·1. The conducting powers of the pure metals given in the following table shows the places which the above metals take in the series:—

	Conducting power at °.
Silver	100 00
Copper	95·95
Gold	77·96
Zinc	29·02
Cadmium	23·72
Cobalt	17·22
Iron	16·81
Nickel	13·11
Tin	12·36
Thallium	9·16
Lead	8·32
Arsenic	4·76
Antimony	4·62
Bismuth	1·245

THE ORIGIN OF THE TERM "VULCANIZATION."—Mr. Thomas Hancock, in his *Personal Narrative*, &c., gives the following explanation as to the origin of the word Vulcanization :—"In preparing to carry out the new process on a large scale, it appeared desirable to give the material a more definite name than the 'change' which I had adopted for the purpose of my specification; and, whilst discussing the subject amongst my friends, Mr. Brockendon proposed the term 'VULCANIZATION,' and, as no better suggested itself, I determined to adopt it, and it is now known by that name both in Europe and America. It owes its origin to the Vulcan of mythology, as in some degree representing the employment of sulphur and heat, with which that mythological personage was supposed to be familiar."

GUTTA PERCHA, the latter word pronounced *pert-sha*, is a gum, taken from a tree called by that name by the Malayans, in whose peninsula this tree grows. The natural order of the tree is *sapotaceæ*. It grows to a considerable height, and may sometimes be found more than six feet in diameter. The gum or juice is obtained by tapping; and it is stated that one tree will produce more than 30 lbs. weight annually. The most valuable property of gutta percha at the present day is that of its insulating powers, rendering it most valuable for telegraphic purposes, although its application for other purposes is still extensive.

IT has long been a desideratum among electricians to obtain a battery having the constancy of Daniell's without the annoyance attending the use of a porous cell. Two such batteries have been described lately. One is the invention of M. Jacobini, and consists of a glass vessel, in which is placed a cylinder of copper pierced with holes; outside this is a large cylinder of zinc. The copper cylinder is filled with powdered sulphate of copper tightly pushed down, and the remainder of the space in the glass vessel is filled with water, so as to saturate both the sand and the powdered sulphate of copper, and the arrangement is covered up. Several hours elapse before the electric current begins to develope itself actively. It then increases for a few days, and finally sinks again till its power becomes constant. Father Sechi has had a battery of this kind in use for three months, and reports that it is as efficient as when first constructed.

MR. FRANCIS RONALD, of Hammersmith, published a description of his electric telegraph in 1823. It was to consist of clocks showing letters, timed together, but wholly independent of each other, and wholly independent also of a line of wire which was to be insulated, in tubes of glass, between the two places where the clocks were respectively to stand. When the person desirous of sending a signal saw on his own clock the signal which he wished his correspondent to note on the distant clock, he charged the conducting wire by an electrical machine, which was to produce the divergence of two pith balls at the distant clock; and under the conditions of perfect coincidence of movement in the clocks, the warning to look for the signal might reach the correspondent at the right moment, whose attention was to have been secured by causing an electric spark to fire a pistol in the first instance. Mr. Ronald's was not a combined system of apparatus, constructed so as to work reciprocally, but three separate and independent elements of communication—viz., the two clocks and the line of insulated wire, arranged in a kind of partnership, for the purpose of producing a combination of effect by a coincidence of action.

ROYAL INSTITUTION LECTURES.—Professor Tyndall began a course of lectures on Electricity (adapted to an educated juvenile auditory) on Saturday, December 26, his subject being "Electricity at Rest, or Static," the leading principles of the science being abundantly illustrated by experiments. After a few introductory remarks on the importance of experiments as the means of investigating into the causes of natural phenomena, such as rain, snow, thunder, and lightning, Professor Tyndall proceeded to show that the simplest method of obtaining electricity was by friction, in the cases of dry glass rubbed by dry silk (with amalgam spread upon it), and of dry sealing wax and other resinous bodies, rubbed with dry flannel—the electrified bodies attracting and being attracted by unelectrified matter. The electricity produced on the glass is termed vitreous, and that on the sealing-wax resinous; but these names were shown to be incorrect, inasmuch as when the rubber was changed the electricity of the wax was produced on the glass and that of the glass on the wax. The electricity obtained from glass by friction with silk is now termed positive, and that obtained from sealing wax by friction with flannel is termed negative. The Professor demonstrated the fundamental law of electric action; that bodies charged with the same electricity repel each other, while bodies charged with opposite electricities attract each other:—Positive repels positive and attracts negative; negative repels negative and attracts positive. We cannot excite one of those electricities without at the same time exciting the other. When, for example, a body is electrified by friction, the *rubber* is electrified at the same time; and the electricity of the rubber is always the opposite to that of the body rubbed. It was shown that the substances termed conductors are those which permit electricity to pass freely through them, and that others, termed insulators, stop its progress. The theory of electric fluids, though quite hypothetical, was thus explained as being exceedingly useful in comprehending many phenomena:—Electrical attractions and repulsions are supposed to arise from two invisible fluids, each of which is self-repulsive, the two fluids being mutually attractive. Both fluids are supposed to be mixed together in unelectrified bodies. The act of electrifying by friction consists in the forcible separation of the two fluids: one of them is diffused over the rubber and the other over the body rubbed. Thus, when glass is rubbed with silk the positive fluid is supposed to cover the glass like a film; and when sealing-wax is rubbed by flannel the negative fluid is supposed to cover the wax like a film. The positive fluid repels the positive and attracts the negative; while the negative fluid repels the negative and attracts the positive. The body to which the fluid adheres is attracted or repelled with the fluid, and hence arises the attractions and repulsions which experiment reveals.—The second lecture was mainly devoted to experimental illustrations of the phenomena of induction. The theory of electric fluids supposes that the negative and positive fluids exist as one compound fluid in an unelectrified body. The Professor demonstrated that when an electrified body was brought near an unelectrified one, but not into contact with it, the electrified body decomposed the compound fluid of the unelectrified one; attracting one of its constituents and repelling the other. This forcible separation of the two fluids is termed "induction." When rubbed glass (which produces positive electricity) was placed near a wooden ball coated with tinfoil, the side of the ball next the glass was charged by induction with negative electricity, the positive being repelled to the other side, the mere proximity of the electrified body, without contact, charging the neutral body with the opposite electricity. The repelled electricity was free; but the attracted electricity (negative to positive or positive to negative) was held fast by the inducing body; but it was shown that, if such an induced body be connected for a moment by a conductor with the earth, the free electricity will escape; and that also, on the removal of the inducing body, the electricity formerly held captive will become free and the induced body remain electrified. The Professor next explained the principle of Volta's electrophorus, and extemporised a very cheap and efficient one—*i.e.* a small circular sheet of zinc, with a stick of sealing-wax for a handle, gutta-percha or vulcanized india-rubber being used as the plate to be excited by friction with flannel, &c. When the zinc was placed on the india-rubber, and then lifted by the handle, it was found to be charged with positive electricity. The lecture concluded with an explanation of electric condensation, being introductory to the study of the Leyden jar.—The third lecture was mainly devoted to experimental illustrations of the principle and action of the electric machine and the Leyden jar and battery. It was shown that, if we increase the quantity of electricity imparted to a conductor we increase the density of the electricity: that the density of the electricity on a sphere is the same at all points of its surface; that on a plate the density is greatest at the edges; and on an elongated conductor the density is greatest at the ends; and also that when this conductor ends in a sharp point the electricity at the point is so great that the electricity discharges itself into the air. The electric machine consists of two parts—the insulator, excited by friction, and the prime conductor. The Professor stated that the first electric machine, consisting of a ball of sulphur, which was rubbed against the hand, was invented by Otto von Guericke, Burgomaster of Magdeburg, in 1671. Afterwards a sphere of glass was introduced, then a cylinder of glass, and finally a round glass plate, which was rubbed with dry silk. Various forms of the electric machine were exhibited in action. When the glass plate of the large machine was turned by a handle, so as to cause it to pass between the silk rubbers, it was positively electrified. The electrified glass then acted by induction upon the prime conductor, attracting the negative electricity and repelling its positive. The conductor was furnished with points, from which the negative electricity streamed out against the excited glass. Thus the prime conductor was charged, not by directly communicating to it positive electricity, but by robbing it of its negative, the positive remaining behind. In the Leyden jar, the inner and outer sides of which are coated with tinfoil, the charged interior coating acts by induction across the glass on the outer coating, attracting the positive and repelling the negative electricity. By the escape of the latter, the jar takes a larger charge. A number of these jars, when connected with the machine and with each other, formed the Leyden battery; several of the powerful effects of which were exhibited, such as the vaporisation of silver wire. The Professor formed a Leyden jar by standing on an insulating stool, and clasping the hand of his assistant, placed on the ground, wearing at the same time a vulcanized india-rubber glove. When the machine was turned the two hands and glove formed a charged Leyden jar.—In the fourth lecture Professor Tyndall proceeded to show how two bodies oppositely electrified discharge to each other with a bright spark; he stated that, in like manner, when two oppositely-electrified clouds discharge towards each other, the track of the lightning marks the course of the electric current, and thunder is the sound of the spark. If the body through which the atmospheric electricity passes be a good conductor and of sufficient size, no harm is done; but the resistance to the passage of the electricity offered by trees, houses, and animals, frequently causes their destruction. Before proceeding to the illustration of the principles of Voltaic Electricity, or Electricity in Motion, the Professor exhibited the leading phenomena of magnetism, explaining the action of the magnetic needle as an indicator of the direction of electric currents. The construction of the voltaic battery was then shown in detail, and the deflection of the needle was produced by strips of zinc and copper dipped in acidulated water, and also from the same substances introduced into an apple and a lemon, and also by cutting a beef-steak by means of a knife and a silver fork. The voltaic battery is composed of a series of cells containing a liquid and two metals; and the wire proceeding from each end of the series of cells, when connected, forms what is termed the circuit. This connecting wire, when the current is

passing, becomes magnetic, attracting iron filings; and when the wire is coiled round a bar of iron, and a current of electricity is produced, the bar becomes a magnet. By this means magnets of enormous power are constructed sufficient to support the weight of many tons. In conclusion, the power of the great electro-magnet of the institution was exhibited, in its sustaining heavy weights, a scuttle of coals, and even the Professor himself.—The fifth lecture began with further explanatory illustrations of the law of the electric currents, showing that when two currents flow in the same direction they attract each other, but when they flow in opposite directions they repel each other; and proving that this was the case with the helix, or coil of wire, surrounding the core of the electro-magnet, as well as with the electro-magnet itself. He stated that some philosophers had gone so far as to suppose that electric currents circulate round the atoms of a magnet; and that magnetic attractions and repulsions are really due to the attractions and repulsions of these little molecular currents. The remainder of the lecture was devoted to the phenomena of electro-chemistry. All bodies are now supposed to be composed of atoms, the smallest particles into which matter can be divided: thus, the air is said to be a mixture of atoms of the gases oxygen and nitrogen; water to be made up of atoms of the gases oxygen and hydrogen, and common salt of the metal sodium and the gas chlorine. By the chemical action set up in the voltaic battery, due to the action of oxygen on zinc, it was shown that these various bodies could be broken up and their respective elements set free at the opposite poles of the battery. Our limited space prevents us from going further into the interesting details of experiments made during the researches within the walls of the Royal Institution, to which the world is mainly indebted for the remarkable applications of the electrotype, and important application of electro-chemistry. By means of the electric lamp several electro-chemical phenomena, such as the decomposition of water, the formation of the lead-tree, &c., were beautifully shown on a white screen.—Concluding lecture. Beginning with experimental illustrations of the phenomena of "induced currents," Professor Tyndall showed that when the two ends of a flat coil of covered wire were connected with a galvanometer (a magnetic needle surrounded by a wire), and a second flat coil was laid upon it, and the two ends of the upper coil were connected with a voltaic battery; the instant the current commenced to flow through the upper coil a current was excited in the under one, which was shown by the deflection of the needle. The direction of the current in the under coil was opposed to that of the current in the upper one. The current excited in the under coil, called an *induced current*, is only of momentary duration. The coil through which the current from the battery flowed is termed the "primary" coil, and that connected with the galvanometer is termed the "secondary." Both at making and breaking the circuit a momentary induced current was excited; that generated at making being opposed in direction to the primary, while that generated at breaking is in the same direction as the primary. Thus, also, when a magnetic pole was brought in contact with the secondary coil, a current was excited; and when the pole was withdrawn another current was excited. When a bar of iron was placed within a hollow coil, on touching the bar with a magnet the iron was magnetised and a current excited in the surrounding coil. On withdrawing the magnet the iron lost its magnetism, and an opposed current was excited in the coil. It was shown that, by multiplying the coils of the secondary, these induced currents could be raised to a high degree of intensity, and by making and breaking the primary circuit in quick succession, a correspondingly quick succession of induced currents may be obtained. This was proved in the apparatus termed the magnetic hammer. It is chiefly "induced currents" that are employed for electro-medical purposes. The latter part of the lecture was devoted to the exhibition of the light and heat developed by the voltaic battery. It was stated that the heat generated is proportional to the resistance overcome; hence, when a current passed through silver and platinum wires of the same thickness, the latter, being the worse conductor, is the most heated. It was also shown that a heated wire offers more resistance to the passage of the current than the same wire when cooled; and that, if we cool a wire rendered ret-hot by a current by plunging it into water, we diminish the resistance and augment the flow of electricity through the wire, and raise the uncooled part to a higher state of incandescence. Lastly, the Professor exhibited and explained the action of the electric lamp, emitting a light almost rivalling that of the sun, from which, by means of a prism, a most beautiful spectrum was produced. The course was concluded with remarks on the great advantages of scientific study as a branch of education.

PRICES CURRENT OF INSULATING MATERIAL

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Genuine mixed, first and second qualities . . .	2/6 per lb.
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second ,, ...	1/7 to 1/8 ,,
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TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	107 to 110	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	3/8 to 5/8	—
5	United Kingdom Telegraph .	3	$\frac{3}{4}d$ to $\frac{1}{2}d$.	—
10	Mediterranean Extension Tel. .	all	3 to 5	—
5	London District Telegraph Co..	all	$1\frac{1}{2}$ to 2	—

TO CORRESPONDENTS.

SHACKLE.—The publication of your letter would not, we feel confident, effect the object you have in view.

HISTORIAN.—The first patent for "improvements in giving signals and sounding alarums in distant places by means of electric currents transmitted through metallic circuits" was granted to William Fothergill Cooke, of Breed's-place, Hastings, in the county of Sussex, Esquire, and Charles Wheatstone, of Conduit-street, Hanover-square, in the county of Middlesex, Esquire. It passed the great seal on the 12th June, 1837. The specification is of enormous length, occupying fifty-nine pages of closely printed matter, and the various parts of the apparatus are illustrated by upwards of forty diagrams.

J. F. B.—Your favour was received too late for insertion this week.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street West; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms (paid in advance):—

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TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

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Half ditto	2	10	0
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THE TELEGRAPHIC JOURNAL.

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TELEGRAPHIC PROGRESS.

THE telegraphic operations of the past year contributed largely towards the development of the system both at home and abroad. The lines constructed are far more substantial and efficient than those constructed in preceding years. Valuable improvements were introduced and adopted, and the advantages derived therefrom have already justified the additional expenditure. The working of the lines has been more regular and certain, and a considerable saving effected in the amount of battery power. In the United Kingdom some hundreds of miles of new lines were erected by the various companies during the year, and many of the old lines, which had, from the wear and tear of time, been greatly impaired, were restored by the substitution of new wires and apparatus of improved quality and description.

The important subject of aerial, or what is generally designated pole insulation, at no period, perhaps, engaged the attention of telegraph engineers and electricians to a greater extent than during the past year; and several valuable improvements were effected in the old system, which have greatly contributed to the more economical and efficient working of long circuits. Although earthenware, porcelain, and glass insulators are still in demand and extensively employed, the appearance of a rival in the shape of ebonite has led to great improvement in their manufacture, shape, and size, which has greatly enhanced their value in practical telegraphy. In addition to these improvements in the science of telegraphy, various useful instruments have been contrived to ascertain the resistance presented by the conductor to the passage of the electric current, and for the detection of injuries and "faults," which must greatly tend to facilitate the labours of those entrusted with the management of our telegraphic lines.

We have also to notice the introduction of several ingenious and valuable "printing" instruments, such as Hughes', Bonelli's, Casselli's, and those distinguished as "alphabetical," by Wheatstone, Henley, Wilde, and others, which in time must effect a great change in the transmission of intelligence from place to place by the rapidity with which it can be accomplished.

Submarine telegraphy, which had long suffered undeservedly from "instructive failures," made a great step towards regaining public confidence. The Atlantic Telegraph Company, with renewed energy, determined to make another effort to realize the great object for which it was formed—the uniting of the Old and New World. Although matters, to all appearance, progressed favourably—the necessary capital subscribed, the form of cable decided upon, the contractors' tender accepted, and a decision arrived at to submerge the cable in 1864,—from prudential motives, as we readily believe, the great work has been postponed until next year. Another cable of considerable political and commercial importance left our shores to be laid in the Persian Gulf, to form one of the great telegraphic links of communication between England and its eastern possessions. In its construction all the most recent improvements have been adopted in the preparation of the copper, in the application of the insulating material, and in the furnishing of a protective sheathing and its protection from oxidation.

Indications already abound that the present year will be an "eventful one" in both land and submarine telegraphy. Several extensive projects are spoken of, and are only held in abeyance until the Money Market has assumed a more favourable aspect. Vigorous efforts will be made to carry out the important line between India and the Australian Colonies, for which purpose a company is formed, upon the direction of which are to be found the names of the most influential merchants connected with Chinese, Indian, and Australian commerce.

The great question as to the best form of cables for deep-sea purposes will again engage the attention of telegraph engineers, as there still exists a great diversity of opinion upon the subject. We have numerous designs of ropes proposed, some of which were subjected to experimental tests under the direction of the late Telegraph Committee; among the most promising we may mention those planned by De Bergue, Messrs. Glass, Elliot, & Co., Allan, Sinnock, Clark, Wells & Hall, Siemens, Rogers, Silver & Co., Macintosh, Hooper, Duncan, and Wright, each possessing great strength, combined with lightness, flexibility, and smallness of bulk, all of which we intend fully to describe in a future number, together with an account of various experimental tests to which they were subjected under our personal superintendence at the Government works.

TRAIN SIGNALLING.

SOMETIMES we think, as the swift train carries us along, making fifty miles a question of as many minutes—and counting, as we often do, the posts at stated intervals, on which are stretched the wires bearing the familiar, though not less woundrous, waves of electricity—"How could the traffic have been carried on without the telegraph?" And yet for many years it was, although, perhaps, the traffic was not what it now is. What would the London and North-Western Railway *now* be minus its telegraph? We know how great the prejudice was *once* against its introduction upon many lines, whose managers would sooner lose a portion of their traffic now than be without their telegraph. If you ask—Why? we say, look at its *convenience*. Suppose a train is late, you, by the telegraph, obtain the reason of delay—anxiety is thus removed; or, if an accident has been the cause, the telegraph is used to send relief. Your luggage, perhaps, is left behind; instinctively you hasten to the telegraph, and by its aid you get your luggage by the following train. Who that has travelled much by rail can fail to know the uses and *convenience* of the "Railway Telegraph?" Perhaps we may stretch the word "convenience," and say the telegraph is *needed* on a railway; but here must end our epithets. We know it *has been* done without; and even now there are existing lines—the Blythe and Tyne for instance—still without their telegraph.

But now we wish to say a word on *safety*—not convenience. We feel our ground is very firm, our latitude extremely broad, when once we speak of "safety;" the whole community will back us up, and those who travel frequently by rail—no very small proportion of our population we opine—will give us thanks for sharpening a weapon for their benefit.

Signalling trains along the line by telegraph from station to station, or, when these are wide apart, from point to point, at intervals best suited to the traffic,—this is an element of safety to the traveller which, we assert, no line should be without. "Convenience" is not the word we would apply to it, because it is rather more than "*in*convenient" to be smashed. We hold it a duty paramount upon our railway men, who night and

day incessantly hold the lives of hundreds in their custody, to give their *first* attention to the *safety* of these lives; and when the traffic on our lines is such that often not two miles of railway intervenes between the trains, does not our unassisted common sense suggest that, if we keep these trains apart, if only separated by a mile of ground, one element—a most important one—of danger is removed? We know that trains may leave the rail, and thus cause loss of life, and clearly it is not the telegraph to which we must resort for aid against *this* peril; but when our "goods" and passengers are jumbled up, a fast train often following behind a slow one, what else can save an accident if it be not the rule to keep a given space between each train perfectly clear? The telegraph alone will aid us in this case; and the plain fact that on our crowded lines some scheme for "spacing" out the road is usually adopted now, the plans, as numerous as the lines, has induced us thus to call attention to the system as a whole, and soon we hope to give our readers details of the plans adopted, pointing out their merits and defects, and hope thereby to stimulate inventive brains to the production of a better contrivance than any tried as yet.

We think the subject one of such importance that Government itself should take it up, and issue a commission to determine which is the system that comes nearest to perfection, and offer rewards for some improvement.

OCEANIC TELEGRAPHY.

By Dr. G. C. WALLICH, F.L.S.

(*Continued from p.* 41.)

It would occupy too much space were we to enter into the whole of the facts bearing on the muddy deposits, with whose presence, over a considerable area of the sea-bed, the sounding-machine has made us acquainted. But there is one point to which we must invite attention, inasmuch as its importance can hardly be over-estimated; and yet, strange to say, it has heretofore been almost entirely overlooked.

In some of the deeper soundings, both on the North and Mid-Atlantic routes, fragments of rock have been brought up. How is the occurrence of these to be accounted for, and what does it betoken? The question is an intricate one, and, so far as our present information goes, does not seem to admit of a perfectly satisfactory solution. This much may be said, however, that their presence on the immediate surface layer of the sea-bed is only reconcilable with one or other of the following suppositions:—They must either have been recently dropped by some means from the superincumbent waters, have been deposited by floating ice during past periods of the earth's history, must occur in beds which were once exposed above the surface of the sea, or be drifting about the bottom through the action of currents.

Now, in no case hitherto recorded have these stones been of large size—probably not larger than a hazel nut—but they present undoubted traces of attrition. Fish, as is well known, sometimes swallow small stones, and, as a matter of course, get rid of them in time; but this would not meet the requirements of the first of the above suppositions, inasmuch as it is obviously improbable that so many fish with stones in their stomachs should be moving about the ocean as would be necessary to account for the fact; and it is still more improbable, if not absolutely impossible, that fish could have conveyed such substances from the distant shores, where they are alone obtainable. So that, viewing this circumstance in conjunction with the fact that no floating ice now-a-days traverses the areas referred to, it is quite certain that the matter is inexplicable on the first supposition.

If deposited from floating ice during past periods of the earth's history, (according to the second supposition, which is by no means impossible,) it follows as an inevitable consequence that the muddy deposits are local in character, and that certain areas of the sea-bed consist of bare rock; or that they are swept away by currents as fast as they are produced. We regard the first of these two views as most conformable with the evidence; for, although there is reason to believe that deep-seated currents prevail with sufficient force in some of the shallower tracts of the Atlantic to move the fine particles of which these deposits are for the most part composed, there is no ground whatever for supposing that they are ever powerful enough to sweep along large objects, such as the stones of which we have been speaking. It will be seen, therefore, that we are fully justified in laying stress on the possibility that extensive areas of exposed rock may occur along the basin of the Atlantic, which have hitherto escaped detection. The third and fourth suppositions are thus disposed of likewise.

But the facts just set forth involve another very important consideration, which, as supporters of no particular creed, we deem it necessary to notice. In assuring ourselves of the absence of currents as a source of danger in Oceanic Telegraphy, we no doubt gain a material point. But to some extent the gain is counterbalanced, and in this wise. Assuming that the bed of the present ocean has been subject, at some antecedent period of the world's history, to the denuding action of atmospheric and terrestrial influences, and has thus been impressed with characters similar to those we see around us on dry land (and that it has been so there is no valid reason to doubt), whatever asperities may have marked its surface when it was first submerged, must remain stamped upon it up to the present time. The denuding action of water in a state of motion is very great; but that of water in a state of comparative quiescence, such as prevails along the sea-bed, must be extremely limited, if it operates at all. Atmospheric agencies, which wear away the rugged features of one district on land and reproduce them on another, are powerless either for good or for evil at the sea-bed. And hence it is certain that, however much the muddy deposits may be constantly contributing towards the toning down of the minor inequalities, they can exercise very little effect as regards those more extensive alternations of level, the absence of which along the sea has been assumed solely because the means heretofore adopted have been inadequate for their detection.

But let us now turn to the living tenants of these deep abysses. It has already been stated that, although the evidence of the vitality of the minute shell-covered creatures obtained in the course of the earlier soundings was altogether inconclusive, more recent observations have established the fact that the conditions prevailing at extreme depths are not incompatible with the maintenance of animal life. The observations in question were made at the close of 1860, during the survey of the North Atlantic route by H.M.S. *Bulldog*. Into the details of these it would be out of place to enter at present; but the proofs they involve may be stated in a very few words.

Thirteen living star-fishes, differing in no important particular from a species common on our own and most northern coasts, were brought up from a depth of 1,260 fathoms, or very nearly a mile and a half, at a point midway between the southern extremity of Greenland and Rockall, and 250 miles distant from the nearest land. These star-fishes, however, cannot be said to have been captured by the sounding-machine, for they came up adhering by their spine-covered arms to the last 50 fathoms of the sounding line, not as voluntary exiles from below, but owing to their having coiled themselves around a material from which they found it impossible afterwards to disengage themselves. Now, apart from all other evidence, the facts in connection with this particular sounding were sufficient to indicate that the star-fishes had been raised from the sea-bed itself, and had not grasped the line whilst floating in some stratum of water intermediate between it and the surface. But by a singular piece of good fortune, the question as to their last resting-place admitted of definite determination on evidence that they bore along with them. To comprehend the value of this it is necessary to mention that, by means of a separate observation taken upon the same spot, the bottom was found to consist almost entirely of the minute shell-covered organisms already referred to; and, taking into consideration the fact that many of the shells were completely filled with the gelatinous substance of which their bodies are composed, and, lastly, the fresh appearance of this substance, the probability is very great that they, in common with the star-fishes, had lived and multiplied at the bottom. But the only circumstance which ought to be accepted as direct proof of their vitality—namely, motion after reaching the surface—was wanting; as, indeed, it well might be, since the passage through the vertical mile and a half of water occupied nearly an hour, and the change of conditions to which the creatures became subjected during that period must necessarily have been very great. Nevertheless, the chain of circumstantial evidence was rendered complete, for, on examining the stomachs of the star-fishes, they were found to contain the minute shelled creatures in abundance: thus clearly

establishing the fact of the star-fishes having attached themselves to the sounding-line whilst it rested on the bottom, and adding the strongest confirmation to the view that the minute creatures referred to were brought up from their natural habitation.

But it was not to be expected that a fact so subversive of all preconceived notions regarding the conditions essential to the presence of animal life on the ocean would be received without the usual amount of salutary scepticism. And hence, on its being boldly announced, not only that highly-organised animals had been brought up from so vast a depth, but that they actually arrived at the surface in a living state, scientific men shrugged their shoulders, and demanded the production of the most complete proofs. These proofs we submit have been produced, and they serve to show that, instead of organic life being carried on in defiance of the conditions so erroneously held to be incompatible with it, the presence of some of these conditions is indispensable to its continuance. In order, however, to render intelligible the doubts that were expressed on the subject, and the precise bearing of the evidence brought forward with a view to dispel them, it is necessary to draw attention to the conditions on which the determination of the question depends.

According to the generally accepted opinion regarding the geographical distribution and vertical limits of marine animal life, the presence of one set of conditions is essential, that of another incompatible with it. Thus we are told that a certain amount of aëration of the water, especially with reference to the quantity of oxygen gas contained in a given volume, and the previous existence of vegetable life in some shape or other, are indispensable to the maintenance of animal life; whereas the increase of pressure beyond a certain degree, and the total absence of light, determine the limit in depth beneath which, it was contended, no living being could exist.

Now, although in the present state of our knowledge, it is difficult to conceive that any animal, no matter how low in the scale, can live in default of a supply of oxygen, we are by no means called upon to believe that this gas is in reality absent in sea-water at great depths.* From observations conducted many years ago by an eminent French experimentalist, M. Biot, it would appear that the swimming bladder of fishes contains a larger quantity of nitrogen than oxygen when they happen to have been captured near the surface; and a larger quantity of oxygen than nitrogen when brought up from a depth of a few hundred fathoms. The researches of other observers would also tend to confirm the view that the quantity of oxygen held in solution by sea-water increases rather than diminishes with the depth; and on theoretical grounds, moreover, there is reason to believe that the presence of oxygen is inseparable from the pressure which prevails at great depths.

In the case of creatures belonging to the higher order, as, for example, fish, the conditions that have been laid down are no doubt indispensable. They cannot support life beyond a comparatively moderate depth; and, as a general rule, it may be taken for granted that no living organism, demanding a supply of free air for its sustenance, or whose structure is of such a kind as to be inordinately affected by an increase of the pressure to which it is subject in shallow water, could, by any possibility, survive a single instant after descending lower than a few hundred fathoms. But there is a large class of creatures, inhabiting the ocean at ordinary depths, whose structure is so universally permeable by fluids that, assuming other conditions to be favourable and the transitions from a low to a high degree of pressure to be sufficiently gradual, it is immaterial whether the medium around them be pressed upon by one or by one hundred atmospheres. In the case of these creatures, as in that of a human being living under ordinary atmospheric pressure, it is only essential that the force should operate uniformly both within and without the body. Hence, in so far as mere pressure is concerned, there is no reason why creatures of the class referred to (and star-fishes are amongst the number) should not be able to exist at all depths.

With regard to the previous manifestation of vegetable life which is said to constitute a condition essential to the existence of animals, both terrestrial and marine, it is only desirable to point out that, were this really a law of nature, it would at once negative the assumption that animal life can be maintained at extreme depths; for, if vegetable products are indispensable for the nutrition of the animal, and no vegetable structures are capable of living in default of a certain amount of light, inasmuch as no light can possibly penetrate to the profounder abysses of the ocean, animal existence must of course be rendered impossible.

But whilst recent explorations of the sea-bed have indubitably indicated that animals can live at those vast depths, they would also seem to show that vegetable life, in any form at least in which we have heretofore detected it, is not co-existent; for whensoever vegetable structures have been found amongst the organic or inorganic matter of the deposits, the peculiar condition of their soft parts has invariably been such as to indicate their having lived in shallower zones, and only descended to the bottom on life becoming extinct. It is manifest, therefore, that the law referred to, however stringently it may apply to terrestrial life, admits of exceptions in the case of marine forms. How these exceptions are provided against remains yet to be ascertained.

But, it may be asked, what are these mysterious little atoms of which so much has been said, and which play so important a part, not only in the composition of the present sea-bed, but of vast tracts of existing dry land.

The animal, as already stated, is one of the lowest in the scale of creation. It consists of a minute particle of viscid matter, not unlike the fluid but yet granular portions of honey both as to consistence and colour, and, like honey, devoid of organization. Nevertheless, it possesses vital contractility, and the power of altering its shape to any extent. The little mass is not naked, however, but, in virtue of another vital faculty inherent in it, is able to extract calcareous matter from the water in which it lives, and re-secrete it in the form of the exquisite shells known to naturalists under the name of *Foraminifera*. In the deep-sea species, to which we are particularly referring, the shells consist generally of a number of chambers ranged in more or less symmetrical order, and each communicating with the rest and with the outer world by one large aperture, and a number of minute pores studded over the entire surface. Through these the little animal is continually projecting, and as continually retracting, delicate thread-like feelers, composed of the same substance as the rest of the body. By means of these feelers it performs the movements of which it is capable, and, in all probability, is enabled to provide itself with food. Hence it will be understood why it was stated in a former portion of these observations, that in the absence of these movements it becomes almost impossible to determine whether the object before us is alive or dead.

But although this wonderful little creature demands special notice, owing to the share it takes in the composition of the deep-sea deposits, numberless other forms are to be met with, equally simple in their nature, but still more beautiful in their structure. And this leads us, in the last place, to inquire whether or not there is reason to apprehend danger from their attacks upon a submerged telegraph cable.

On this point we can speak with confidence. If there be any source through which the abrasion of a cable, either by contact with other substances, or the attacks of creatures able to bore into its coverings, and thus destroy or impair its insulation, may be obviated, it is through the gradual incrustation that these humble shell-builders are sure to form around it. Accordingly, it becomes of the utmost importance to select, as far as is practicable, those areas of the sea-bed which are covered by the foraminiferous deposits, and to avoid those which are bare. Minute Annelids unquestionably exist even at the greatest depths, and amongst these there are some capable of doing mischief. That they can penetrate gutta-percha solely by means of the boring organs with which they are provided, we altogether disbelieve. But, in most cases, there is ground for suspecting that their penetrative powers are materially aided by secretions capable of acting chemically on the substances attacked. Of the nature of the secretion, or its possible effect on caoutchouc or gutta-percha, we know nothing. But this is no reason for repudiating the possibility of an event, which if brought about only once in the 2,000 miles of cable, would prove fatal to its working integrity. It only remains to be added, that we are no alarmists. We would neither conjure up, magnify, nor ignore danger. What we desire and believe to be indispensable, if telegraphic communication across the Atlantic is to be viewed in any other light than as a source of national chagrin, is that measures should be forthwith adopted to add to the scanty information we already possess regarding the sea-bed; under the firm conviction that whatever difficulties may present themselves, they require only to be understood to ensure their being surmounted.

* M. Pasteur, the French chemist, in his recent experiments on Ferments, has sought to show that some of the so-called Infusoria are able to exist without oxygen.

TO ERECT A LINE OF TELEGRAPH.

(*Continued from p.* 29.)

As three different lengths have been given for the arms or cross pieces, viz., 18, 19, and 22 inches, it is necessary to explain that the reason of this is to prevent the wires coming into contact when an accident occurs, by which one of them breaks away from the insulator that supports it.

The longest arm should be fixed nearest the top of the pole; then (12 inches lower down) the 20-inch arm, and finally the 18-inch arm. If the wire comes away from the top arm, there is then no fear of its coming in contact with those on the lower arms, unless it be very slack, in which case the wind may drive it occasionally against the nearest wire, and thus an intermittent contact would arise.

This article has been forestalled in last week's number of the Journal as to the method of fixing the wires used for lightning-conductors (see p. 43); but the writer might have added a word of caution, that when painting the poles care must be taken not to leave the earth-wires covered up. A wise precaution is to take a knife and scrape the conductors after the poles have been painted. The wires themselves, when first fixed, should project four inches at the top of the pole, above the cap, and be twisted twice round the butt before the pole is set. In notching the poles to receive the arms, do not fix them all on one side, but alternately, so as to preserve an equilibrium of weight upon the pole. Being solicited to give a list of tools required, and the cost of such as are necessary to erect a line of telegraph, the following will, it is trusted, be found useful and correct:—

Lined bass, each	£0	4	0
Draw vice and tongs, per pair	0	17	6
12-inch spanner, each	0	12	6
Drawing tongs, per pair	0	5	0
Monkey wrench	0	7	0
Half dozen 3-square files, selected	0	7	0
Hand-saw	0	3	0
Tenon-saw	0	3	6
One pair 7-inch pliers	0	3	6
One pair 5-inch ditto, solid	0	3	0
One pair long-nosed pliers	0	2	0
One soldering-iron	0	4	0
One wood mallet	0	1	0
Two chisels, 1s. each	0	2	0
Two screwdrivers, 1s. 6d. and 2s. each	0	3	6
One large hammer	0	3	0
One small ditto	0	2	0
One plane	0	4	0
Two augurs, 1s. 4d. and 1s. 6d. each	0	2	10
Two gimblets, 4d. and 6d. each	0	0	10
One drawing-knife	0	2	0
One shave	0	1	6
Two squares, 2s. and 3s. 6d. each	0	5	6
One pick	0	4	0
One spade or tool	0	2	0
Two tar-pots, 4s. and 5s. 6d. each	0	9	6
Two brushes, 1s. 3d. and 1s. 9d. each	0	3	0
One fire-pot	0	3	6
One spirit-lamp	0	2	6
Pair blocks and fall	1	2	0

Of the above a lineman will require a complete kit, the labourers only wanting picks and spades. Surely for a regular employment, such as that of a telegraph lineman should be, the investment of £7 6s. 8d. as his stock in trade is not more than it is right to expect.

So far, then, for the construction of overground lines, and it is assumed that the remarks apply equally to works on railways or highways. In every case be particular to leave the ways clear, and do not consider that your work is finished if the ground is not well filled in and levelled; and if any subterranean work has been carried out requiring paving or macadamizing, consult with the Board surveyor whom to employ to set all straight. Ten to one he will do it himself; but the expense will be less than if you select a man of your own choice, however good he may be, in which case you will find a bill following you for doing it twice over "to the satisfaction of the overseers." A fair charge for setting a road in order is 6d. per square yard.

For simply raising stones, opening a trench two feet deep, filling in and setting (exclusive of the above charge), 10d. per yard run is a fair estimate. It will cost this to do it, and matters little if you employ a contractor or do it with your own men.

In underground work remember Mr. Varley's dictum: gutta-percha will remain unchanged for months *in air* if the light is excluded, and *for years* in water if coated with Stockholm tar. A good plan to adopt, therefore, to preserve your gutta-percha-covered wires is to dig a trench two feet deep,—this will be sufficient to be out of the way of frost,—place in it some wooden boxing rather larger than your cable of wires requires. The boxing may be rough cut and not planed; the rougher the better, as the tar and pitch will creep into it. An ordinary square groove will answer, or it may be V shaped. Prepare your wires by a double covering of tarred yarn, and when laid in the boxing pour into it warm tar, with sufficient pitch mixed in it to allow it to become solid as quickly as it becomes cold. Before it gets hard, and while running over the sides of the boxes, tie on the lids—plain, flat, rough pieces of scantling—and, finally, with a tar-brush give the whole outside a thick coat of tar. While this is warm, fill in your trench, and the earth will cling to the boxing on all sides, excluding air, and making the job as complete as possible. There need be no fear of rapid decay of gutta-percha if this plan is adopted. Lines so laid eight years ago are as good as when the trench was first filled in; and as affecting the question of maintenance it is most important.

To pursue this question efficiently we shall next prepare a summary of The General Telegraph Act, and append the forms of notice required to be given in compliance with the same.

THE INTERNATIONAL EXHIBITION, 1862.

(*Continued from p.* 42.)

W. T. Henley, H.M. (United Kingdom, 2,908), exhibits specimens of cables covered and laid by him. They are entirely similar in general construction to those already described, and have been for the most part successful. A list of these cables is contained in Table B.

TABLE B.—CABLES LAID BY MR. HENLEY.—OCTOBER, 1862.

Date when laid.	WHERE LAID.	Number of Conductors.	Length of Cables in Statute Miles.	Lengths of Insulated Wire in Statute Miles.	Period of Working.
1857	Ceylon to Mainland of India	1	30	30	5 years.
1859	Spain to Africa	1	25	25	Not known.*
1859	South Australia to Tasmania	1	240	240	†2½ years.
1860	Denmark, across Great Belt	6	14	84	2 "
1860	Denmark, across Great Belt	3	14	42	2 "
1860	In Arracan	1	116	116	2 "
1860	Barcelona to Mahon	1	198	198	2 "
1860	Minorca to Majorca	2	35	70	2 "
1860	Iviza to Majorca	2	74	148	2 "
1860	St. Antonio to Iviza	2	76	152	2 "
1860	Across rivers in Egypt	3	6	18	2 "
1861‡	Beachy Head to Dieppe	6	80	320	4 wires good.
1862§	Across an arm of Cork harbour	11	—	0·625	7 months.
1862§	Across Blackwater River, Ireland	4	—	1·75	6 "
Number of miles of cable and insulated wire laid			908	1,445	
Deduct out of working order			125	125	
Number of miles of cable and insulated wire in working order			783	1,320	

The following tables give the details of the principal cables hitherto laid by all makers. It is divided into three heads: 1st. Those which have been wholly successful, and are now working (October, 1862); 2nd. Those which may be said to have been partly successful, inasmuch as they worked for some time; 3rd. Those which wholly failed, or, in other words, never worked at all. The writer has added in each case what he considers the probable cause of the total or partial failure. The dimensions of the wires, &c., have been given in the Birmingham wire gauge, because measurements in decimals of an inch would have given a fallacious idea of the accuracy of the data. It is well known that in practice the same number does not always mean exactly the same size. A short table is added giving the strict value of the gauges in decimals of an inch.

* Old Atlantic. † One hundred miles out of working order.
‡ Manufactured in 1853 by Messrs. Glass, Elliot, & Co., but laid by Mr. Henley.
§ Silver & Co.'s india-rubber.

TABLE C.—LIST OF SUBMARINE CABLES HITHERTO LAID.

PART I.—*Cables which are now at Work.*—October, 1862.

No.	Date when laid.	From	To	Conductors. No.	Conductors. Size per B.W.G.	Size of Insulator per B.W.G.	Outside Wires. No.	Outside Wires. Size.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Maximum depth of Water in Fathoms.	Weight in Tons per Statute Mile.	Length of time the Cables have worked.	Remarks.
													Years.	
1	1851	Dover	Calais	4 wires.	16	2	10	1	27	108	30	6	11	The first iron-covered cable.
2	1852	Keyhaven	Hurst Castle	4 do.	16	7	—	16	3	12	—	—	10	The first application of pure india-rubber to submarine cables. The outside covering was made of wires plaited together.
3	1853	Denmark	Across the Belt	3 do.	18	4	9	2	18	54	15	4	9	
4	1853	Dover	Ostend	6 do.	16	2	12	2	80½	483	30	5¾	9	
5	1853	Frith of Forth	— —	4 do.	16	1	10	8	5	20	—	7	9	Four cables, galvanised, and twisted together.
6	1853	Portpatrick	Donaghadee	6 do.	16	2	12	2	25	150	160	6	9	
7	1853	England	Holland	1 wire.	16	1	10	8	120	120	30	1¾	9	One of four similar cables laid in 1853-1855. They were found too weak, and, after having been repeatedly broken and repaired, three of the four have been lifted and replaced by a very heavy cable, No. 20 in list, part I. The gutta-percha was covered with tape saturated with Stockholm tar. Copper 63 lbs. per mile.
8	1854	Portpatrick	Whitehead	6 wires.	16	2	12	galvanised 2	27	162	150	6	8	
9	1854	Sweden	Denmark	3 do.	16	2	10	2	12	24	14	6	8	One wire of this cable is out of working order.
10	1854	Italy	Corsica	6 do.	16	1	12	1	110	660	325	7½ to 8	8	These cables have never cost anything for repairs; they are similar to the cable intended to connect Sardinia and Africa, No. 5 in list of failures, part III. They are also similar to No. 48, part I., and manufactured at the same time.
11	1854	Corsica	Sardinia	6 do.	16	1	12	1	10	60	20	7½ to 8	8	
12	1855	Egypt	— —	4 do.	16	2	10	1	10	40	—	5¼	7	
13	1855	Italy	Sicily	1 wire.	16	2	10	1	5	5	27	5¼	7	
14	1856	Newfoundland	Cape Breton	1 strand.	14	1	12	9	85	85	360	2·5	6	The first cable in which a strand was used for the conductor.
15	1856	Prince Edward's Island	New Brunswick	1 do.	14	1	12	9	12	12	14	2·5	6	
16	1857	Norway across	Fiords	1 do.	14	1	10	6	49	49	300	2¾	5	
17	1857	Across mouth of	Danube	1 do.	14	1	12	9	3	3	—	1¾	5	
18	1857	Ceylon, and across rivers in India and Ceylon	Mainland of India	1 do.	14	00	12	8	60	60	45	2¾	5	
19	1858	Italy	Sicily	1 do.	16	2	10	1	8	8	60	5¼	4	
20	1858	England	Holland	4 wires.	13	0	10	00	140	560	30	9¾	4	One of the wires of this cable was rendered useless for some time by a nail. This injury was repaired in 1859. Two of the four wires had Chatterton's compound between the layers of gutta-percha. This compound has been used in almost all subsequent cables. Copper 119 lbs., gutta-percha 180 lbs. per mile.
21	1858	England	Hanover	2 strands.	16	3	12	6½	280	560	30	3	4	Has been frequently broken.
22	1858	Norway across	Fiords	1 strand.	14	1	10	6	16	16	300	2¾	4	
23	1858	Dardanelles	Scio	1 do.	14	1	16	15	115	115	200	0·89	4	These cables have been occasionally out of order, but it is believed are now repaired and at work; the lengths are taken from a chart.
24	1858	Scio	Syra	1 do.	14	1	16	15	85	85	200	0 89	4	
25	1859	Alexandria	— —	4 strands.	16	3	10	1	2	8	—	5¼	3	
26	1859	England	Denmark	3 do.	16	3	12	5½	368	1104	30	4	3	
27	1859	Scio	Smyrna	1 strand.	14	1	16	15	40	40	40	0·89	3	These cables have been out of order from time to time; it is believed they are now at work. The lengths are taken from a chart.
28	1859	Syra	Athens	1 do.	14	1	16	15	105	105	150	0·89	3	
29	1859	Sweden	Gottland	1 do.	14	1	12	9	64	64	80	2·5	3	
30	1859	Folkestone	Boulogne	6 strands.	14	3	12	0	24	144	32	9½	3	
31	1859	Across rivers	in India	1 strand.	13	0	9	2	10	10	—	4½	3	
32	1859	Otranto	Avlona	1 do.	13	1	18	16	50	50	400	0·89	3	The length of this cable is taken from a chart.
33	1859	Malta	Sicily	1 do.	14	1	10	5½	60	60	79	3¼	3	
34	1859	Jersey	Pirou in France	1 do.	14	00	12	5½	21	21	15	3¾	2½	
35	1859	South Australia	Tasmania	1 do.	16	1	10	8	140	140	60	2	2½	
36	1860	France	Algiers	1 do.	14	0	10	14 steel covered with hemp	520	520	1585	1·14	2	The first cable in which the specific gravity was diminished by hemp spun round each separate wire of the sheathing.* This cable was not completed until September, 1861.
37	1860	Denmark	(Great Belt)	6 strands.	16	1	12	1	14	84	18	8	2	
38	1860	Denmark	(Great Belt)	3 do.	16	1	10	1	14	42	18	5½	2	
39	1860	In Arracan	— —	1 strand.	13	0	18	14	116	116	50	0·89	2	
40	1860	Barcelona	Port Mahon	1 do.	14	1	16	12½	198	198	1400	1·25	2	This cable, although faulty, continues to transmit messages.
41	1860	Minorca	Majorca	2 strands.	16	3	18	12	35	70	250	1·9	2	
42	1860	Iviza	Majorca	2 do.	16	3	18	11½	74	148	500	1·9	2	
43	1860	St. Antonio	Iviza	2 do.	16	3	18	11½	76	152	450	1·9	2	
44	1861	Corfu	Otranto	1 strand.	14	0	10	5½	90	90	1000	3·4	2	
45	1861	Norway across	Fiords	1 do.	14	1	10	6	16	16	300	2¾	1¾	
46	1861	Toulon	Corsica	1 do.	14	0	10	14 steel covered with hemp	195	195	1550	1·14	1¾	
47	1861	Malta	Alexandria	1 do.	8	0000	18	11	1535	1535	420	1·85	1	The longest successful cable. The greater part is in depths of less than 100 fathoms; strand laid up in Chatterton's compound. Copper 347 lbs., gutta-percha 347 lbs. per mile.
48	1861	Beachy Head	Dieppe	6 strands (4 good).	16	1	12	1	80	320	30	7½ to 8	—	Part of the old cable constructed for Sardinia-Africa, No. 5 in list, part III. It lay for many years dry and exposed.
													Months.	
49	1862	Abermawr, Pembroke	Grenore, Wexford	4 strands.	14	1	12	3	63	252	58	5¼	6	This cable was covered with hemp and bitumen.
50	1862	England	Holland	4 wires.	13	0	10	00	130	520	30	9	2	The shore ends of this cable were covered with hemp and bitumen. They weighed 15½ tons per mile.
51	1862	Across rivers in Ireland	—	—	—	—	—	—	—	1½	—	—	7	Two short pieces of cable, the conductors of which are insulated with india-rubber.
			Totals						5345½	9456½	These totals can only be taken as approximations, as the exact length of several of the cables is not known to the writer.			

* Since writing the above this cable has failed—temporarily at least.

(*To be continued.*)

TELEGRAPHY A PROFESSION.

The periodical announcement of lucrative appointments at the disposal of the Under-Secretary of State for India, on the electric telegraph staff of that country, naturally incites our young men to profitable study, and encourages that healthy spirit of emulation so essential in those who seek advancement. In the month of May next, the competitive examinations will be commenced in London, for twenty-five appointments, of a monthly money value, varying from 3,000 rupees to 150 rupees; and, judging from the number of communications we have received on this subject, we conclude that there will be a large number of candidates, and an animated competition. The conditions of appointment have been previously published in this journal. Arbitrary, yea, absurd as are some of the requirements, considered in their bearing upon the occupation to be engaged in by successful candidates, there will be found many who are prepared to "try" every subject set by the examiners.

It becomes necessary, therefore, for those of our readers who contemplate entering the arena, to fortify themselves, by every possible means, for the crucial tests to which they will be subjected. To those who have the means at their disposal, we would recommend a careful preparation, by a practical electrician, prior to examination. We do not urge this course as essential to success, or we should discourage that large class of plodding, self-instructed students, to whom the world of science has been, and ever will be, so much indebted; but we advise a special course of instruction wherever the educational qualification exists, without the experimental knowledge so necessary in the business of a telegraph engineer.

In our advertising columns will be found an announcement from a practical telegraphist, who conceives that a fitting opportunity now presents itself for the professional preceptor to introduce himself to public favour; and in this view we heartily concur. Architecture and engineering have long been honourable professions, success in either of which has only been attained by application and study under the most experienced masters. The science of electricity, in its practical applications, is but imperfectly understood, and we are anxious to see the best method adopted whereby its development may be ensured, and a school of telegraphy established, which shall adorn the birth-place of the art.

A new sphere has been opened up, wherein the experienced electrician may turn his practice to profitable account. Mr. Dodwell has initiated a course which is calculated to greatly exalt telegraphic science, and to assist those who may be desirous of attaining to proficiency in a profession which is becoming more important as nations advance in civilization.

WHO IS MR. REUTER?

All the world is asking this question. Is the mysterious individual who tells us through the public press what battles have been won or lost—what kings have decamped, or what words emperors have spoken an hour since in far-off countries, which will shake the political world to its foundation—is this Mr. Reuter an institution or a myth? Must we count his name like one of those which have an existence in the heathen mythology only, or is he a man like ourselves, having "feelings, organs, dimensions," &c.? If he be, by what extraordinary organisation does he manage to gather up over night a summary of events over the entire continent, and to place it before us as a startling interlude between coffee and toast at the breakfast table? Nay, how is it that through his mouth, if we may so term it, we hear for the first time of a successful battle in China, or of the madness of the Southern slave states of America? To answer all these questions is the purpose of the present paper, and we may claim for this journal the privilege of being the first to satisfy the public inquiries relative to this very interesting subject. That Mr. Reuter, omniscient as he may appear to be, shares our common humanity. His history is like that of all courageous and energetic men, who, seizing upon a new idea, work it persistently and silently, until one fine morning, from comparative obscurity they suddenly find their names famous.

The practical success of the first working telegraph on the continent—that between Berlin and Aix-la-Chapelle in 1849—convinced Mr. Reuter, in common with every thinking man on the continent, that a new era in correspondence had arisen, and he determined to avail himself of its facilities for the public advantage. The first office for the furtherance of telegraphic communication was opened at Aix-la-Chapelle, an admirable spot, lying so conveniently between the east and west of Europe. This office formed the first centre of that organisation which has since gathered up into the hands of one man for all general and public purposes the scattered electric wires of the world. In order to correct breaks in the most direct line of transmitting news he had to supplement the wire with contrivances of his own, so as to insure priority of information. Thus, the better to gain time in the journey between Aix-la-Chapelle and Brussels, he employed a service of carrier-pigeons. By this means on this distance alone he was enabled to anticipate the mail train between the two places by six or eight hours. In order to ensure regularity and safeness in transmission, each message was despatched by three different pigeons, which made the passage from Brussels to Aix-la-Chapelle in an average period of one hour. When the telegraphic line was extended from Aix-la-Chapelle to Quievrain, on the Belgio-French frontier, and the French Government extended their line from Paris to Valenciennes, there remained a gap of only five miles in the line of telegraph between the French and Prussian capitals, but insignificant as this space was, the delay thereby occasioned was enormous. To obviate this, relays of saddled horses were always kept in readiness to forward despatches between the two points.

As line after line was opened in succession, each was made subservient to his system, and when the cable between Calais and Dover was successfully laid in 1851, Mr. Reuter, who had become a naturalised subject of Her Majesty, transferred his office to London, which thenceforth was put in connection with the principal continental cities. Up to this time Mr. Reuter confined his attention to the conveyance of commercial despatches, but it now struck him that the time was arrived for making the telegraph the handmaid of the press. One of the distinguishing characteristics of the British press is the vast expense to which it goes for obtaining exclusive intelligence. The principal morning papers were in the habit, at this time, of running expresses at an enormous cost. The *Times*, for instance, possessed a fast steamer, which conveyed to England news from Calais the moment it arrived from Paris. M. Reuter offered to supply the obvious want; but without success. The obstacles presented by the existing system were not yet to be overcome; and besides, a certain prejudice had been excited against political telegrams in consequence of the errors they so often contained. Sometimes they had to be translated into three or four languages before they reached the British public, and errors were but too likely to creep in under such circumstances. A second time, too, he was equally unsuccessful.

Mr. Reuter did not lose heart, however, as he foresaw that the days of daily political telegrams were near at hand. "All good things are three," says the German proverb, and for a third time, in 1858, Mr. Reuter made his offer to the press. This time, however, he sent his telegrams for one whole month to all the editors in London, leaving it to their option whether they used them or not. The quickness with which Mr. Reuter received his telegrams, and the accuracy of the information they contained, were soon appreciated, and one newspaper after another became subscribers. His telegrams did not attract particular notice, simply because no great public event gave him an opportunity of showing the value of his system. So matters went on until the 9th of February, 1859. On that day the Emperor made his famous speech, in which he threatened Austria through her ambassador. His ominous words were uttered at one P.M. in the Tuilleries, and at two P.M. the speech was published in a third edition of the *Times*, and had shaken the Stock Exchange to its foundation. This was a dramatic hit, and thenceforward every one looked out for Mr. Reuter's telegrams. The war in Italy followed, and, in order to receive authentic accounts from all quarters, Mr. Reuter sent special correspondents to the French, Austrian, and Sardinian camps; and on one occasion it happened that he published three different telegrams of the same battle from his correspondents in the different armies. Many of these telegrams were, from their very nature, short; but on occasions, important speeches, parliamentary debates, and other political intelligence of especially English interest were telegraphed *in extenso*. The adoption by the English press o[f] the few short but decisive facts communicated by the telegraph did n[ot], however, do away with the "exclusive special correspondents" o[f] the chief morning papers; on the contrary, it allowed them mo[re] time to elaborate their information, and to go into detail. A do[zen] lines gave us the fact of the victory at Solferino; but the battle itself a

week afterwards stood before the British public with all the photographic strength and completeness of the *Times*' special correspondent's pen.

The impartiality and accuracy by which Mr. Reuter's telegrams were characterised, succeeded in procuring him the confidence of the press. The newspapers of the chief provincial towns were not long in availing themselves of his system, which ended in depriving the metropolis of the monopoly of early intelligence. The daily papers of the great towns of the north of England and of Ireland possess exactly the same early telegrams as the London daily papers, by means of Mr. Reuter's system, which posts England as well up in the news of the world, at her furthest extremities, as she is in the metropolis itself.

News from England is, in the like manner, conveyed by Mr. Reuter to all the chief continental cities. Thus the people of St. Petersburg may read every morning abstracts of the previous night's debate in the British Houses of Parliament.

What Mr. Reuter has already done for Europe he is about to do for the other quarters of the globe. It will have been observed that all our earliest information from America, India, and China, the Cape, and even Australia, is derived from this gentleman's telegrams. In all these countries he has located agents, who transmit him news in anticipation of the mails. There being no direct telegraphic communication between England and those countries, Mr. Reuter avails himself of every telegraphic line *en route*. Messages from America, for instance, are telegraphed up to the latest moment to the last port in the Atlantic where the steamer touches; they are then landed either at Queenstown, Londonderry, Galway, Liverpool, or Southampton, whence they are telegraphed to London. News from the East is received in an accelerated manner by a similar method. All the telegrams first come into the hands of Mr. Reuter, whose day offices are near the Exchange, and whose night offices are in Finsbury-square; thus this gentleman is, without doubt, as regards the affairs of the world, the best informed man in it. He gives his political telegrams to the press alone, and never allows them on any account to be communicated beforehand to merchants and bankers for the purpose of speculation.

In order to make the separation between the political and commercial departments of his establishment the more complete, he has removed the former to Waterloo-place, at the West-end, whilst the latter remains at the City offices. These offices are open day and night—the day staff of clerks working from ten A.M. till six P.M., and the night staff—a far more numerous one, in consequence of the far longer hours of work—being engaged in relays from six P.M. one evening till ten A.M. next day. All the offices are connected together by the electric wire, and to still further facilitate the transmission of telegrams to the different newspapers, the wires are being continued from the West-end office right into the editor's room of each journal, who, by means of Wheatstone's universal telegraphic apparatus (a description of which we shall give in an early number of this journal), is enabled to read off his own messages instead of receiving them, as heretofore, by messenger. The pedestrian, as he walks along Fleet-street and the Strand, will perceive high over head what might be termed the political spinal cord of the metropolis; every here and there it gives off right and left fine filaments; these are going to the *Globe*, the *Sun*, the *Morning Post*, the *Herald*, the *Standard*, the *Telegraph*, and all the other daily papers which line this great thoroughfare. These are the lines by which Mr. Reuter puts the whole British public in possession of the thoughts, and records the actions of the rest of the world; and as we watch the wires ruling their sharp outlines against the sky, for all we know they are conveying words which may affect the destinies of millions yet unborn.—*Once a Week.*

REPORT OF THE DIRECTORS OF THE MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED).

THE Balance Sheet for the half-year just ended shows the Company to be in a better position at present than it has been since its commencement.

The improvement in the revenue has been considerable, and, but for the interruption which occurred in the Malta and Alexandria line in the early part of the half-year, there is little doubt that the receipts would have been nearly doubled as compared with the previous half-year.

An interruption has just occurred on the same line again, but from the circumstances with which it is connected, there is little doubt it will be repaired almost immediately, as the lessees of the line entertain no doubt respecting the result.

The Directors regret to announce the decease of Mr. J. W. Brett, one of your Board, which occurred during the past half-year. They have endeavoured to repair the loss which the Company has sustained in his death, by electing, in conformity with the "Articles of Association," Captain A. T. Hamilton, who was formerly a director; and whose valuable services, they feel assured, will conduce to the interests of the Company.

The Company's cables continue in good working order.

The Directors recommend the usual dividend—8 per cent. per annum—on the Preference Shares; and 4s. per share—equal to 4 per cent. per annum—on the Original Capital.

They also recommend the usual addition of 10 per cent. on the gross earnings to the Reserve Fund.

HENRY MOOR, Chairman.
HENRY C. ORTON, Secretary.

158, Gresham House,
22nd January, 1864.

BALANCE-SHEET OF THE COMPANY FOR THE HALF-YEAR TO THE 31ST DECEMBER, 1864.

Dr. *Cr.*

Dr.	£	s.	d.	Cr.	£	s.	d.
Balance of Capital Account (as shown below)........	302	6	11	ASSETS.			
Amount to the credit of Reserve Fund..............	1,092	14	9	Funded Property, Amount of Reserve Fund invested in India Five per Cents.....	547	16	7
LIABILITIES.				Amount due from other lines on account of messages transmitted by this Company to 31st Dec., 1863 ..	17,587	19	6
Deposits on account of messages to be transmitted ..	212	11	6	Sundry amounts due to the Company for messages transmitted	125	14	4
Amount due on account of messages transmitted over other lines, to 31st December, 1863............	12,264	0	3	Cash at Bankers'	338	6	2
Sundry other amounts owing by the Company	98	2	8	,, in hands of Officers of the Company...........	379	0	3
Surplus Balance of Dividend Account	5,009	0	9				
	£18,978	16	10		£18,978	16	10

CAPITAL ACCOUNT—(*Original Line*).

	£	s.	d.		£	s.	d.
Cost of construction and preliminary expenses........	117,984	19	5	Amount received for issue of 12,000 Shares of £10 per Share	120,000	0	0
Unexpended balance transferred to the Capital Account of the Corfu and Otranto Line............	2,503	19	1	Forfeited deposits and interest on investments	488	18	6
	£120,488	18	6		£120,488	18	6

CAPITAL ACCOUNT—(*Malta and Sicily Line.*)

	£	s.	d.		£.	s.	d.
Preliminary expenses	397	14	0	Amount received for issue of 1,500 Preference Shares at £10 per Share	15,000	0	0
Amount of contract for cable	12,100	0	0				
Unexpended balance transferred to the Capital Account of the Corfu and Otranto Line	2,502	6	0				
	£15,000	0	0		£15,000	0	0

CAPITAL ACCOUNT—(*Corfu and Otranto Line.*)

	£	s.	d.					£	s.	d.
Preliminary expenses......	252	5	10	Unexpended balance of the Capital Account of theOriginal Line......	£2,503	19	1			
Amount expended on construction of the Land Line	521	12	4	Ditto of the Malta and Sicily Line	2,502	6	0			
Amount of Contract for the Submarine Cable	20,930	0	0					5,006	5	1
Balance	302	6	11	Amount received for issue of 1,700 Preference Shares at £10 per Share				17,000	0	0
	£22,006	5	1					£22,006	5	1

Dr. DIVIDEND ACCOUNT. *Cr.*

	£ s. d.		£ s. d.
Amount of Dividend on Preference and Original Shares, paid and brought to account in the half-year to 31st December, 1863 ..	3,042 13 4	Surplus balance 30th June, 1863, as per last Balance-Sheet	3,677 4 7
Income-tax on Dividends ..	89 16 8	Surplus balance of Revenue Account to 31st December, 1863....................	5,009 4 4
Amount after payment of the above (carried to Reserve Fund)	544 18 2		
Surplus Balance	5,009 0 9		
	£8,686 8 11		£8,686 8 11

REVENUE ACCOUNT.

		£ s. d.		£ s. d.
Expenses of the Offices, and Stations in London, Malta, Corfu, Naples, Cagliari, and Turin, including Directors' Fees, viz.:—			Receipts for messages in the half-year to 31st December, 1863................	7,001 13 7
Salaries, wages, and agencies	£1,380 2 7			
Rent, Fuel, and Light........	159 10 2			
Miscellaneous and petty expenses........	314 9 3			
Maintenance of the Lines	162 7 0			
	£2,016 9 0			
Deduct Alexandrian Lessees' proportion of the rent of Malta Office to the 31st December, 1863	23 19 9			
		1,992 9 3		
Surplus balance carried to Dividend Account.........		5,009 4 4		
		£7,001 13 7		£7,001 13 7

22nd January, 1864. BENJAMIN NATTALI, Accountant.

Detailed Statement of the Company's Expenditure at its Offices and Stations, for the Half-year ending on the 31*st of December*, 1863.

	£ s. d.	£ s. d.
LONDON OFFICE:—		
Directors' Fees, Salary of Secretary, &c.....................	512 15 5	
Interest on Loan of £1,200 (Hankey)....................	40 5 6	
Rent of Offices, &c..	58 0 6	
Stationery	26 12 2	
Advertising	21 18 5	
Furniture	9 14 6	
Miscellaneous, Petty Expenses..........................	32 18 2	
		702 19 9
MALTA OFFICE:—		
Salary of Superintendent and Wages..................	507 18 8	
Rent of Offices, &c.	60 9 6	
Stationery..	22 17 0	
Postage	37 14 9	
Furniture, and Repairing Offices........................	21 17 10	
Travelling Expenses while Inspecting and Repairing Cable	98 12 10	
Freight upon Goods	11 15 0	
Clothing for Employés	7 1 0	
Materials for Working Cable..............................	21 17 2	
Miscellaneous, Petty Expenses..........................	25 11 4	
		815 10 1
CORFU OFFICE:—		
Salary of Manager and Wages	221 13 6	
Rent of Offices, &c..	41 0 2	
Travelling Expenses	26 14 8	
Materials for Repair of Line..............................	31 13 4	
Postage	8 0 0	
Miscellaneous, Petty Current Expenses	14 3 9	
		343 5 5
NAPLES OFFICE:—		
Salaries	57 0 0	
Postage	0 10 0	
		57 10 0
CAGLIARI OFFICE:—		
Salary..	55 0 0	
Travelling Expenses	16 0 0	
Postage	0 19 9	
		71 19 9
TURIN OFFICE:—		
Salary	25 0 0	
Postage	0 4 0	
		25 4 0
		£2,016 9 0
Deduct Alexandrian Lessees' proportion of Rent of Malta Offices		23 19 9
		£1,992 9 3

[It will be seen from the following report that, notwithstanding the precautions which were observed in the manufacture and submergence of the Malta and Alexandria cable, an interruption of the communication, extending over a period of two months, occurred last year. Advices, contemporary with the publication of the accounts, announce that the line is again faulty. A vessel has already been dispatched with an efficient staff, and fitted with apparatus for raising and making good the damage, and we trust that the anticipations of the directors with reference to its restoration may be realised.]

REPORT OF THE DIRECTORS TO THE PROPRIETORS OF THE TELEGRAPH TO INDIA COMPANY, LIMITED.

IN presenting their Report to the Shareholders, the Directors have the satisfaction of stating that the remaining Assets have now been disposed of, as will be seen by the accompanying Statement of Accounts, and that there are no further liabilities.

Messrs. Glass, Elliot, & Co., the lessees of the line, have intimated that they will make no deduction from the half-yearly payment of £1,250 for the period ending 31st December, 1863, although the through communication was interrupted for about two months; they reserve to themselves, however, the right to claim the amount (£200) at any future time, should they think fit.

The Directors recommend that a dividend, at the rate of 5 per cent. per annum, free of Income Tax, be paid to the Shareholders for the half-year ending 31st December, 1863, payable on and after the 15th instant.

The Directors regret to inform the Shareholders that intelligence has been received of a further interruption on the Malta and Alexandria cable, but they understand from Messrs. Glass, Elliot, & Co., that a ship has been despatched with a proper staff to repair the fault, and that the communication will, in all probability, be restored in about a month from this time.

During the interruption on the Malta cable, this Company will get the benefit of the receipts on the Alexandria, Cairo, and Suez line; and in consequence of the recent increase of the local traffic, the Directors do not anticipate that there will be any deduction from the dividend of 5 per cent. per annum during the remainder of the lease.

Before that term shall have expired it is confidently expected that there will be a further extension of the Telegraph in the direction of Aden, and possibly of India, by which the Company's property will be greatly enhanced in value, and the Directors will be able either to dispose of the line, or to work it themselves, with advantage and profit.

The Directors have to lament the death of one of their colleagues, Mr. Alexander Wilson, since the last meeting of the Shareholders. Under the existing circumstances of the Company, it is suggested that his seat at the Board should not at present be filled up.

In compliance with the requirements of the Act of Parliament, the following Directors retire by rotation, and, being eligible, offer themselves for re-election:—Philip Patton Blyth, Esq., Frederick C. Gaussen, Esq., and John Farley Leith, Esq.

The auditors, J. A. Franklin, Esq., and A. S. Wildy, Esq., also retire, and offer themselves for re-election.

WILLIAM DENT, Director.
WILLIAM MAYO, Secretary.

STATEMENT OF THE CAPITAL ACCOUNT TO DECEMBER 31ST, 1863.

Dr. *Cr.*

EXPENDITURE. January 1st to December 31st, 1863.	£ s. d.	RECEIPTS. January 1st to December 31st, 1863.	£ s. d.
Amount expended to December 31st, 1862, as per last Statement	48,456 3 9	Capital realised, viz.:— Deposit of 20*s*. per Share on 45,400 Shares	45,400 0 0
Examination of Old Cable (Eastern Section):—		Balance received from Red Sea and India Telegraph Company	1,966 6 1
Charter of S.S. "Sir James Duke"........	5,573 9 6	Transferred from Revenue Account to Balance Capital Account	7,864 15 10
Wages of Staff	515 1 1		
Travelling Expenses	336 17 4		
Advertisements	34 16 11		
Furniture, Fixtures, and Fittings	1 15 0		
Interest	175 16 2		
Exchanges and Commission.	11 5 0		
Insurance	0 15 8		
Incidental Expenses	7 19 2		
Law Expenses	117 2 2		
	£55,231 1 11		£55,231 1 11

STATEMENT OF THE REVENUE ACCOUNT FROM JANUARY 1ST TO DECEMBER 31ST, 1863.

Dr. *Cr.*

EXPENDITURE.

January 1st to December 31st, 1863.

	£	s.	d.
Advertisements	26	14	6
Exchanges and Commission .	7	1	5
Agencies in India	864	1	10
Land Line, Inspection, and Maintenance	83	11	8
Office Charges, Postages, Stamps, and Telegrams ..	246	1	10
Printing, Stationery, & Books	93	1	1
Salaries at Home and Abroad, including Arrears and Allowance for Quarters.......	2,333	15	0
Repairs of Cable............	26	3	0
Repairs and Maintenance of Instruments and Batteries.	17	1	3
Establishment of Stations (Victualling Jubal Station)	689	15	2
Rent and Repairs at Home and abroad	201	16	1
Payment to the Egyptian Government	361	19	11
Income Tax on £494 15s. 10d.	18	11	1
Dividend (First)............	1,135	0	0
Incidental Expenses	5	2	6
Travelling Expenses........	1	0	3
	6,209	9	0
Balance	2,544	7	3
	£8,763	16	3

RECEIPTS.

January 1st to December 31st, 1863.

	£	s.	d.	£	s.	d.
Balance of Revenue Account, as per last Statement				494	15	10
Amount of Message Money, less Overcharges returned .				2,432	5	7
Transfer Fees..............				6	10	0
Lease of Line				2,500	0	0
Interest				4	4	9
Assets realised, viz. :—						
Cable	£8,000	0	0			
Sundry Furniture and Instruments	400	0	0			
Telegraph Instruments..	1,971	5	0			
Condensers, &c., at Suez	866	3	10			
Furniture at Suez	20	0	0			
Ship's Condenser	10	0	0			
Furniture, &c., at Aden ..	383	3	1			
Battery, Stores, &c., at Egypt	441	1	0			
Postage Stamps	3	12	3			
	12,098	5	7			
Less charges .	207	9	8			
	£11,890	15	11			
Less, transferred to Balance Capital Account, as above	8,564	15	10			
				3,326	0	1
				£8,763	16	3

BALANCE SHEET OF THE COMPANY MADE UP TO DECEMBER 31ST, 1863.

LIABILITIES.

	£	s.	d.
Dividend (First). — Amount due to Sundry Proprietors .	52	10	0
Balance of Revenue Account, as per Statement	2,554	7	3
Amounts due to Sundry (included above)	109	6	9
	£2,716	4	0

ASSETS.

	£	s.	d.	£	s.	d.
Balance at the Bankers', viz., Current Account..........				112	0	8
Do. do. Deposit Account				750	0	0
Do. of Petty Cash in hand				3	17	11
Bill receivable due January 26th, 1864				29	17	6
				895	16	1
Outstanding Accounts :—						
Due by Messrs. Glass, Elliot, and Co., (included above)	£1,250	0	0			
Agencies	295	7	11			
Syrian Telegraph Company......	275	0	0			
				1,820	7	11
				£2,716	4	0

MATERIALITY OF THE ELECTRIC FLUID.—Mr. Lake, of the Royal Laboratory, Portsmouth, communicated to the *Lancet* a few years ago the results of a singular experiment, which appears to show that the electric agent is really fluid; and that when collected so as not to exert its powers of attraction and repulsion, it obeys the laws of gravitation like carbonic acid and other gases. The electric fluid was received in a Leyden jar insulated on a glass plate. At the lower part of the jar was a crack in the side, of a star-like form, and from around this the metallic coating was removed. On charging the jar, it was observed that the electric fluid soon began to flow out in a stream from the lower opening; and on continuing the working of the machine, it flowed over the lip of the jar, descending in a faint luminous conical stream (visible only in the dark) until it reached the level of the outside coating, over which it became gradually diffused, forming, as it were, a frill or collar. When the jar was a little inclined on one side, there was a perceptible difference in the time of its escape over the higher and lower parts of the lip, from the latter of which it began to flow first. On discontinuing the working of the machine, the fluid first ceased to flow at the lip of the jar, and then at the lower aperture. On renewing the operation, it first re-appeared at the lower aperture, and afterwards at the mouth. This very ingenious experiment appears to establish the fact, that the electric fluid is material, and is influenced, under certain circumstances, by the laws of gravitation. We believe that Dr. Laming has made several experiments to the same effect.

CORRESPONDENCE.

THE BONELLI TYPO-ELECTRIC TELEGRAPH.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—As a telegraphist of some years standing and experience, I was much pleased with the clear and satisfactory reply of Mr. Henry Cook to your correspondent "J. P." I confess that I had an indifferent opinion of M. Bonelli's apparatus as one of practical utility, but Mr. Cook's explanations have modified my views considerably. An apparatus capable of transmitting matter at the rate stated by Mr. Cook would undoubtedly effect a great change in our telegraphic system, and confer a boon on the newspaper interest of the country. I am well acquainted with the powers of the Morse's instrument for transmission, and which are well defined in Mr. Cook's letter; and, perhaps, it is not generally known, that the old double instrument can be employed with greater effect than either Morse's or Bain's in the transmission of long speeches, when manipulated by expert telegraphists.

The great drawback to the adoption of the typo-telegraph of M. Bonelli appears to me the expense of constructing and maintaining a line where five or six wires are necessary for working the instrument. Suppose that one or two of the line wires were broken, could any communication be carried on then?—Yours, &c.,

25 Jan., 1864. D. P. L.

MR. ANDREWS' PNEUMATIC APPARATUS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It is with the liveliest gratification I have seen the publicity given through your columns to the attempt of Mr. France to gain credit for the productions of another's labours. It is not because of any personal feeling *against* Mr. France, or *in favour of* Mr. Andrews, that I say *this is a step in the right direction.* I speak feelingly, as one who has more than once been treated like Mr. Andrews. It would be a grand thing if some law could be made to prevent the appropriation of other men's ideas, and meet the case of those who are not content with this, but must seek to get the credit for them also. The fact is, patents are useless if you cannot defend them; or if you can, another snaps up your idea, if good, adds a screw here and there, a wheel, or perhaps a spring, and trumpets up the thing as his. It is time a stop was put to all this paltry system; and let the first step be to expose those who, lacking may be the wit themselves, seek to grow fat on others.—Your obedient servant, LUX.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Amongst the number of your subscribers none have hailed the appearance of your Journal with greater pleasure than myself. It supplies a desideratum long felt; and I am inclined to think that the *Telegraphic Journal* will, in some degree, revolutionize the telegraphic world.

Formerly there has been a striking exclusiveness in connection with telegraphy and its concerns. The public, from the original high rates of telegrams, instinctively avoided a telegraph office, and, surprising to say, manifested little desire or aptness to peep beyond the curtain of facts into the sanctuary of causes. The superficial ideas they obtained created immense astonishment and admiration, but the idea of an inquiry into electrical principles and their application to telegraphing was terrific. The clerks, from the distances which separated them, and want of other means of communion than the wires, were not induced to act combinedly, as for instance, in the formation of societies and clubs, or in meetings for mutual improvement, &c.: the absence of telegraphic journalism prevented the interchange of ideas, the general dissemination of news of a professional character, and the communication of electrical knowledge.

Now, however, the public are becoming better acquainted with the working of telegraphy and with electricity as a science. Lower prices for messages, erections, &c., are attracting them into close relationships with the telegraph. Telegraphists have their improvement societies, their dramatic clubs, their insurance companies, dinners, cricket clubs, &c., and, lastly, we have our journal—the agent for conveying to all quarters news, notions, and science—so that a clerk at a remote station can hear of the affairs of the whole telegraphic world. We have opened to us, in the publication of your Journal, a new phase of existence; a means of communion and concentration of interests.

In reading the manner in which you purpose to subdivide the contents of your paper, I was pleased to see that you apportion a part to all classes; that you do not treat of science to the exclusion of general news, nor of the latter to the exclusion of something for the poor clerks. Your columns are a medium alike to all. For its ultimate success I entertain no doubt, and I hope I am not illogical in supposing that, after a certain maximum of remuneration is received, an increase in circulation will produce a proportionate decrease in price.—I am, Sir, yours, &c.,

Stockton, 21 Jan., 1864. W. H. NETTLETON.

TELEGRAPHIC NEWS.

MR. CYRUS W. FIELD has again arrived in England, being his thirty-first voyage across the Atlantic, to renew his efforts to unite by telegraph the British and American shores. The fidelity of Mr. Field to the great and important undertaking, so long identified with his name, has become proverbial on both sides the Atlantic. We trust that the effort which is to be made next year to lay down the cable will prove successful, as there is every reason to believe that it will be the case.

WE regret to learn that Mr. Statham, so long the manager of the Gutta-percha Company, Wharf-road, City-road, and identified with telegraphic operations, both sea and land, has been suffering for some time from severe illness; and the last information received represents his health to be in a most precarious and dangerous state.

SOME interesting and successful experiments have recently been made between the Liverpool and London stations of the Electric Telegraph Company, with a telegraphic apparatus invented by M. Casselli, and termed the "Pantelegram." M. Casselli has succeeded, by very ingenious mechanism, in more practically carrying out, through the medium of the wires, the principle of transmitting to distant stations *fac simile* copies of messages as written by the sender, and also exact counterparts of designs and portraits. It seems to be expected that the invention will prove a valuable adjunct to the progress of telegraphy.

THE Bonelli Telegraph Company are now erecting, on each side of the Mersey, enormous poles, or masts, for supporting an aerial cable across that river. During the last storm, the poles first erected were completely destroyed, and the operations of the company were temporarily stopped. Some idea of the manner in which the new works at Runcorn are being done, may be gathered from the fact that the new top-masts are as large as the main-masts of the old standards. The new masts are 2 feet 6 inches in diameter at the base, and 136 feet in height.

THE LAST TELEGRAPHIC FEAT.—The transmission of Messrs. Scholefield and Bright's speeches, delivered before a meeting of their constituents, in the Town Hall, Birmingham, on the 26th instant, shows the wonderful capacities of the electric telegraph. The transmission of the speeches commenced at half-past 8 o'clock, P.M. Three instruments were employed—namely, Morse's—put in action by Mr. Varley's relays. After a stoppage of about half an hour, between 11 and 12 o'clock, P.M., the work was proceeded with until half-past 2 o'clock, when the transmission was completed. The matter, as it was received, was despatched to the newspaper offices. The report of the speeches, as it appeared in the *Times*, contained, in round numbers, 49,000 letters, or 12,000 words, occupying six columns. The length of the paper-ribbon upon which the speeches were printed, exceeded one statute mile.

MAGNETIC TELEGRAPH.—The employés of the Magnetic Telegraph Company, with their friends, held their third annual soiree in the Lesser Trades Hall, Glassford-street, Glasgow, on Wednesday evening last. E. Tansley, Esq., District-Superintendent, occupied the chair. Having discussed an excellent tea, the chairman, after expressing the pleasure he felt in presiding on the occasion, gave an outline of the rapid progress which had been made in the science of telegraphy during the last few years, and also referred to the important works on which some of our most eminent electricians are now engaged. The meeting was then entertained with songs and recitations from several talented amateurs, after which, the hall being cleared, dancing was commenced, and kept up till an early hour.

TELEGRAPH LINE BETWEEN GOREY AND ST. HELIER.—This line was completed on Wednesday, the 20th inst., and on Thursday the batteries and instruments were tried on it, and showed it to be in perfect working order. The rate for telegrams between St. Helier and Gorey will only be 6d. The line is erected upon poles for a distance of 4½ miles from Gorey Pier, where the new station is situated, to the corner of the Belvidere-road, in George Town, where the last pole is standing. Here the overground wire is connected with a piece of cable laid underground through the streets for rather more than half-a-mile, and which ends at the principal office in Library-place. The stretches of the wire between the poles are rather longer than is usually the case on overground lines, the average length of the spans being 220 yards. There is one particularly long span near Gorey, the wire being stretched from the top of the Martello Tower on the common to the highest part of the road, a distance of 430 yards. The line of route was laid down by Mr. Gerhardi, the Company's Superintendent for Jersey, and has been executed under his personal superintendence. This day the line was formally opened by the transmission of the following messages from the Superintendent to the Lieut.-Governor:—"To His Excellency Major-General Burke Cuppage, Lieut.-Governor of Jersey.—Gorey, January 23, 1864.—I take the liberty to address to your Excellency this, the first Telegram transmitted by the new Line between St. Helier and Gorey, to inform your Excellency that the line is from this moment open to the public. —C. GERHARDI, Superintendent for the Island of Jersey." The Lieut.-Governor replied as follows:—"His Excellency the Lieut.-Governor congratulates the Submarine Telegraph Company on the accomplishment of an object which must be of so much benefit to the public at large, and thanks them for their communication."

THE directors of the Electric and International Telegraph Company have resolved to recommend to the proprietors, at the general meeting to be held on the 11th of February next, to confirm a dividend of £3 10s. per cent. for the last half-year.

MR. F. JAMES, late a clerk in the employ of the Electric and International Telegraph Company, at Edinburgh, but who was more recently employed in the Government telegraph service at Suez, went across the Creek, on the 14th inst., to spend a day's pleasure with two friends, and while indulging in sports of the field, accidentally shot his left arm off; mortification ensued, which, we regret to announce, proved fatal within twenty-four hours of the accident.

THE Kurachee papers give out a report of the fact that Kurachee had been fixed upon as the head-quarters of the Persian Gulf and Bagdad line of telegraph.

THE *Marian Moore*, which left the Downs on the 17th August, arrived at Bombay on the 27th November. Upon examination of the cable, which had been kept in water-tanks on board, the insulation was found to be higher than it was when it left Woolwich: the fact is a corroboration of well-conducted experiments. All the machinery required for the laying of the cable was in position on board the vessel, and it was expected that the *Marian Moore* would be able to proceed to its destination at once, towed by H.M. steamer *Semiramis*. Lieut.-Col. Stewart, Sir Charles Bright, Dr. Esselbach, and Messrs. Webb and Laws were all well, and everything appeared favourable to success. The *Zenobia* and the *Corromandel*, two fine Government ships, were also appointed to assist in the work.

THE *Cossack*, 20, Captain W. R. Rolland, received orders on the 21st inst. to hold herself in readiness to sail for Tripoli and Benghasi. She is to convey Mr. Saunders, electrician to Messrs. Glass, Elliot, & Co., to these places, for the purpose of examining into the state of the Malta and Alexandria telegraph cable, which has stopped working since the 13th inst. Mr. Saunders was expected from Marseilles on the night of the 22nd inst. A steamer especially fitted for such employment has been ordered from England to the Mediterranean to repair the cable. It has been rumoured, also, during the week, that the Oran and Carthagena cable had met with an accident; we have made enquiries of the contractors, who assured us that they have not received any information confirmatory of the statement.

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.—The annual meeting of the chief officers of the North-Western section of this company's system was, as usual, held in Manchester, convened by Mr. J. P. Bidder, on Monday last, when nearly 40 were present, Mr. G. G. Newman, the superintendent of the district, in the chair; Mr. Whittingham (Liverpool) occupied the vice-chair. These meetings assume the character of a dinner, and this one was universally admitted to have surpassed its predecessors in the completeness of its arrangements, the number of attendants, its creature comforts, and the genuine friendly spirit that pervaded the whole of the company, indicating thereby how good an understanding exists among the staff of this district, the largest in the system, and on this social occasion, as at all times, Mr. Newman must feel it no small pleasure to meet his officers. We know not a more effectual means for establishing a happy relationship between the members of any public service, than the coming together, personally, on an occasion of this description, and how much good to the governors and the governed is induced by them, it would be hard to determine. We understand the North-Western district is the only one which annually adopts these meetings; if so, we are sure if the example were more generally carried out, the company and the public alike must be benefited. The dinner over, the chairman (Mr. Newman) proposed the usual loyal toasts, and the Electric and International Telegraph Company, mentioning, in the case of the latter, that it was pleasing to know that its history had been one of uninterrupted and rapid progress. Mr. J. P. Bidder proposed "The Chairman;" in doing so, he remarked that the company, in their response, would manifest their approval of the virtues "honesty, uprightness, and manliness;" honesty, because his (the chairman's) actions had been consonant with his words, and in justification of their confidences; uprightness, because he was truthful in the administration of the principles of truth and justice; manliness, because he had ever been gentlemanly in his conduct towards all, in a district which he was proud to govern, and those present proud to belong; he had earnestly endeavoured to obtain right to his staff, and, therefore, all were glad to recognise him as their superintendent. Mr. Whittingham proposed "The Commercial Staff," which was responded to by Mr. Edmond (superintendent's office); also "The Engineering Staff," praising its perfectness, as instanced by the gale in December last, when this company was the only one open for two or three days, between Manchester, Liverpool, Leeds, and London; this was responded to by Mr. Noble (Lancaster). The "Chief Clerks" was then given, and responded to by Mr. Wade (Birmingham). An interest was given to this meeting by the farewell of Mr. Nadal (Manchester), who, after serving the company about sixteen years, had accepted a more important and lucrative appointment on one of the local papers. In his speech he compared telegraphing, in its early period, with the present time, which was peculiarly striking to all present. In a most touching speech, he said he could not leave a service under such circumstances, and having so many friends in it who he should esteem so long as he possessed an active heart, without many and deep regrets. As we have indicated, the meeting altogether was a most happy one.

THE electric telegraph now extends, by way of Russia, and within 200 miles of Kratchka—a frontier emporium, close to the Chinese empire—between which and Pekin, about 1,000 miles distant, there is a regular post established, so that now it would be quite possible to communicate with Pekin, from London, in a week.

PROVISION IN CASE OF ACCIDENT OR DEATH.—In a former number we noticed the fact that a poor man had lost his life while engaged in repairing a telegraph line at Chester, and expressed our regret that there existed no provision for the benefit of the men employed by telegraph companies as has been long the case with railway companies. Miss Oppenheim, the indefatigable secretary of the Telegraph Clerks' Provident Fund, has called our attention to the advantages offered to all those employed under telegraph companies by joining the above fund. The fund is not exclusively intended for clerks and manipulators, but for *employés* of every grade. We have carefully perused the rules of the fund, and the following extracts, we hope, will enable all those who have addressed us upon the subject to appreciate the advantages to be derived by becoming members of the institution:—

RULE 4.—*Sick Pay until Sixty.*

The following table shows the payments to be made every calendar month to insure 10s. weekly in sickness, and a proportion for days less than a week at the end of his or her sickness; the benefit and the payments continuing until sixty:—

Monthly Payments for the Assurance of Medical Attendance, &c., and an Allowance of 10s. per week during illness, until 60 years of age.

Age next Birthday.	s.	d.
15, and under 20	1	1
20, „ 25	1	2
25, „ 30	1	3
30, „ 35	1	4
35, „ 40	1	5

Any member who may be disposed to increase this allowance will be required to pay the increased rate, according to the age at the time of making such increase, *only on the amount of such increase.* Another table shows the amount of monthly payments to be made to secure an assurance of £10 at death:—

Age next Birthday.	s.	d.
15, and under 20	0	4
20, „ 25	0	5
25, „ 30	0	6
30, „ 35	0	7
35, „ 40	0	8

In addition, we quote the following special rules relating to endowments:—"Endowments of not less than £10, or more than £200, may be assured by members for themselves, or for their nominees, at any time, according to the tables. If any member, having assured a personal endowment, shall die before the payments have been completed, then the money received by the society shall be paid to the party nominated by the member, according to the rule below; or if no nomination has been made, it shall be divided among the relatives, according to the statute of distributions. If a member, assuring an endowment for himself or herself, cannot continue the payments, he or she shall give notice thereof to the secretary, and the committee shall thereupon take such measures for the repayment as they may think the case requires. If any member, having assured an endowment for a nominee, shall die before the payments have been completed, and notice thereof shall have been given to the society within six months of the death, together with a declaration in writing, stating that no person is willing to continue the monthly contribution, then the money received by the society shall, at the discretion of the committee, be paid to some relative for the benefit of the nominee, or retained until the period has elapsed at which the payments were to be completed, and then it shall be paid to the nominee; or should the nominee die in the interval, it shall then be paid to the person or persons appearing to the trustees to be entitled to the effects of the deceased nominee. If the nominee, on whose behalf an endowment has been contracted for by any member, shall die before the requisite payments have been completed, then the money received by the society shall be paid to the person or persons appearing to the trustees to be entitled to the effects of the deceased nominee. The secretary shall keep a book, in which a member may nominate in writing the person to whom the money paid for an endowment for himself or herself shall be paid on his or her decease, such person being the husband, wife, father, mother, child, brother or sister, nephew or niece, of such member (18 & 19 Vict., c. 63, s. 31). Any member may revoke such nomination by a written notice to that effect, signed by himself or herself; and it shall be the duty of the secretary to see the nomination erased. The member to pay 3d. to the Management Fund for each nomination or revocation." In glancing over the book containing the rules and regulations of the Telegraph Clerks' Provident Fund, we are glad to find that they have not only been approved of by Mr. Tidd Pratt, but by the directors of all the telegraph companies in England. The Electric and International Telegraph Company have had for some years a provident fund, towards which the company contribute a liberal sum yearly. In a future number we shall place before our readers an account of the benefits which the company's servants have derived from the existence of such a fund.

PHOTOGRAPHIC GROUP OF TELEGRAPHIC ENGINEERS AND ELECTRICIANS.—This photographic group is a reduction of a large composition picture, 35 inches by 22, executed by Mr. A. Brothers, of Manchester, comprising twenty-nine portraits of some of the leading telegraphic engineers and electricians of the day, as well as of other gentlemen connected with telegraphy. The picture has been prepared for a private gentleman, and most of the portraits were taken specially by Mr. Brothers, who has been eminently successful in grouping them in graceful and easy positions. The likenesses are all of them admirable, and as a specimen of photographic art we can commend it as excelling anything in the way of surface grouping we have ever seen. It is not an everyday occurrence; no less than thirty-two printings were necessary to produce the group, yet no defect throughout the print can be seen. Mr. Brothers explains that it is contemplated to form a second group, to include the most eminent men, the present picture being more of a private nature, and composed of some who have less claim to fame than the friendship of Mr. Brothers' client. A reduced copy of the picture is published.

THE KURACHEE AND CONSTANTINOPLE TELEGRAPH.—The *Scindian* describes the construction of the land succession of the Kurachee and the Constantinople telegraph—409 miles—to Guader in the Persian Gulf. Mr. Walton began the work on the 5th July, 1862, and the line was at work on the 30th April, 1863. The wire is carried over the Malan cliff, which overlooks the sea perpendicularly at an altitude of 2,000 feet. The exact height of the line at the eastern edge of the rock is 1,620 feet. The materials for the line over the Malan for a distance of more than ten miles had to be carried to the summit entirely by manual labour. The only pass to the top being on the western face, and too steep for camels. The country is destitute of water and vegetation, and only inhabited by roving Beloochees. The heavy surf prevented the landing of materials except at Omara, Pusnee, and Guader. The boats had to transfer their cargoes to canoes, which were shot through the surf. The line is constructed without a curve. A party of 318 men, of whom four were Europeans—the number afterwards increased to 636 in all—were engaged on the work. The cost of victualling the party by the Commissariat was Rs.29,822, and the total cost of the work was 2¼ lacs of rupees.

MISCELLANEA.

THE UNIVERSALITY OF ELECTRICITY.—Professor Faraday states that there is as much electricity employed to combine the gases in one drop of water as would, if instantaneously liberated, cause the brightest flash of lightning, sufficient to rend the majestic oak or destroy animal life. Such is the universality of electricity that it must be sought everywhere; flowing in an ever-constant stream from the centre of our system—the sun, it is taken up by the planetary spheres, each having its influence upon our earth; passing round our globe in ever-varying currents, it is the cause of terrestrial magnetism; it rules the storms; the clouds collect and are dispersed under its influence; descending lower, it stimulates vegetable and animal life—it is, in fact, vitality; it burrows in the bowels of the earth, causing the aggregation of metals into mines, and deposits precious stones by polar influence. Electricity is, therefore, universal, and every science must be exhausted before the limits of electricity can be ascertained.

MAGNETIC ETHER.—In a paper read at a recent meeting of the Royal Society, the Astronomer-Royal propounds a theory to account for magnetic atoms. The phenomena, in Mr. Airy's opinion, represents the movements of the magnetic ether, which he supposes to overspread the whole surface of the earth as an impalpable fluid envelope several feet in thickness. If we then conceive this magnetic ether to be subjected to occasional currents produced by some action or cecession of action of the sun, which currents are liable to interruption or perversion of the same kind as those in air or water, we have a theory by which the disturbances that occur in the observed phenomena of terrestrial magnetism may be explained.

SEEING AND BELIEVING.—The late Professor Daniell, having been invited to witness the first experiment made with the electric telegraph at the then newly-constructed station of the London and Birmingham Railway, on his return home immediately wrote to his friend, one of the inventors:—"I am quite surprised at, and almost at a loss to account for, the different effects produced upon my mind by *believing* and *seeing*. I had followed, as you well know, all your experiments from the beginning, and was intimately acquainted with both the principle and construction of the apparatus; but, nevertheless, when I saw it in action upon the Birmingham Railroad, I was struck as with something quite new; the facility with which I could myself immediately read signals communicated from a distance, and the simplicity of the means by which I saw you reply to them, and which I felt that I could myself master in five minutes, producing in me something like magic. I received immediate conviction of the possibility of conveying at a distance of 100 miles as quickly as a word could be spelled; and, upon cool reflection, I now feel satisfied that not only must the telegraph be adopted upon all railroads immediately [It was not adopted, however, for some years], but that it will very speedily be had recourse to upon an extensive scale for private communications between great commercial stations."

AN Englishman, lately arrived from Siberia, whither he had gone to arrange telegraphic communication with China, saw an unfortunate Irishman labouring in those snowy wilds. He was loaded with chains, and treated like any Pole; and it appears that he came to this grief through having deserted the British army before Sebastopol. Paddy was found wandering about in Central Russia. He was taken up, as, partly perhaps from an imperfect knowledge of the language, he could give no account of himself.

THE *Times*, in a recent article on the Schleswig-Holstein question, says, "Our readers, indeed, cannot fail to be struck by the remarkable way in which by the help of modern inventions they are carried along every morning with each turn of the dispute, and watch the successive changes with all the interest and excitement of spectators. In former times, when any issue of similar importance hung in the balance, we had no means of watching all the turns of the scales, and had to be contented with periodical announcements of the results. Events moved beyond our sight, and intelligence of them came to us as news of distant movements, the results of which might affect us, but with the actual and immediate course of which we could hardly interfere. Now, by means of the telegraph, all Europe watches the successive changes at the very seat of disturbance. Our intelligence this morning places before the public the movements yesterday afternoon upon the Eider, the state of the weather, the latest decisions of the German Powers, though not, we trust, the last resolution at Copenhagen. Nor is this change conspicuous only in giving us a more exciting and absorbing interest in the course of events. It has a most remarkable effect upon the course of events itself. Instead of its requiring, as in former times, weeks or even months of negotiation before the last resolutions of antagonistic Powers could be communicated to each other, the whole process is effected in a few days, and an army is transported from Vienna to the Eider in less time than it would have taken a few years ago to deliver a message from Berlin to Copenhagen. It was but last week that Austria and Prussia resolved upon the course they would take. The first step of presenting a summons to Denmark was made on Saturday, and the first contingents of the Austro-Prussian troops have already arrived on the scene of action. This rapidity of movement and instantaneousness of communication brings forces into play which were unknown in former times. It gives nations to a certain extent the invaluable power of seeing themselves as others see them before it is too late to be influenced by the knowledge. The aspect which every resolution and movement bears to foreign nations and Governments is immediately mirrored back to the agents. Important influence and advice may be brought to bear at almost every critical moment of the dispute, and may incessantly modify the course of action taken by a wise and considerate Power. We have reason to hope that some such good result may yet avail in the present danger in time to avert the all but commenced hostilities."

THE SUCCESS OF THE FIRST DOVER AND CALAIS SUBMARINE CABLE DESCRIBED IN THE JOURNALS OF THE DAY.—"Fate and Professor Wheatstone have for some time past been at odds as to the future fortunes of the human race, but now the Professor has got the best of it. 'A man can't be in two places at once,' says the old proverb, but, by the aid of electricity, any one of us may be in all the capitals of Europe at the same moment of time. We do not of course refer to the gross physical presentation of a man—to that portion of him which weighs fourteen stone and has the gout—but to his immortal essence, to his intellect, to his will. What matters it in what nook the *eidolon* may be thrust out of the way while the immortal spirit dabbles in shares on the Parisian Bourse, countermands the march of an armed host in Hesse, or gives its opinion of a painted window in the studio of a Munich artist? All these things a man can accomplish without moving from the Electric Telegraph Office in Charing-cross. The sea is no longer an obstacle to the instantaneous transmission of information. The deep waters have been reduced by scientific skill to be the highway of human thought — not, as heretofore, painfully conveyed in lumbering packages, and freighted upon large argosies which required half a year to put a girdle round the globe. Swift as thought on its first conception in a single human mind can thought now be flashed from one capital of Europe to another, and beget, at the distance of a thousand miles, the same sequence of ideas which plays at that very moment round the fretwork of the parent brain. We know not why, in strictness, the transmission of the electric spark 'full fathom five,' or five times fifty fathoms, beneath the troubled surface of the ocean, should affect the mind with greater awe than its instantaneous passage across the solid earth. Still this conquest gained by science over the waves must ever remain recorded as amid the greatest of human achievements since record has existed of the mighty feats accomplished by man. It is wonderful to reflect that, while the great ships 'reel to and fro, and stagger like drunken men,' far, far beneath their keels, amid the wrecks of former days, the current of human thought is evenly flowing on without disturbance or interruption. Let the ship begin to weigh her anchor in an English port, and, before three turns of the chain have been taken on the windlass, the announcement of her departure may now be flashed beneath the waters to the coast of France. The next moment another spark will convey the intelligence to the cities on the banks of the Seine, the Rhine, the distant Danube, and far within the inhospitable dominions of the Russian czar."

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities.	2/8 to 2/6 per lb.
Good re-boiled	1/7 to 1/10 „

INDIA RUBBER.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/6 „

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	107 to 110	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	3/8 to 5/8	—
5	United Kingdom Telegraph .	3	½*d* to par	—
10	Mediterranean Extension Tel. .	all	3 to 5	—
5	London District Telegraph Co..	all	1½ to 2	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street West; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms (paid in advance):—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)...........	0	3	0

Single Advertisements from the country must be accompanied with stamps in payment.

THE TELEGRAPHIC JOURNAL.

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THE ATLANTIC TELEGRAPH.

THE renewed effort about to be made to realise the object for which the Atlantic Telegraph Company was formed, is a subject of no inconsiderable importance to the public at large. We believe that a great amount of misapprehension exists as to the motives which induced the Company to relinquish their intentions of manufacturing and submerging the cable in the present year; of this we are assured, that the Company sought the best advice, the result of which was to defer the manufacturing and laying of the cable until next year. The Company very properly appealed to the members of the late Telegraph Committee of the Board of Trade as to their opinion of the practicability of submerging a cable across the Atlantic ocean, and as to its permanency when laid, and they were encouraged to proceed in their great undertaking by the receipt of the following certificate, now for the first time made known in England, signed by all the members of the said Committee:—

London, 13th July, 1863.

We, the undersigned members of the Committee who were appointed by the Board of Trade in 1859 to investigate the question of submarine telegraphy, and whose investigation continued from that time to April, 1861, do hereby state as the result of our deliberations, that a well insulated cable, properly protected, of suitable specific gravity, made with care, and tested under water throughout its progress with the best known apparatus, and paid into the ocean with the most improved machinery, possesses every prospect of not only being successfully laid, in the first instance, but may reasonably be relied upon to continue for many years in an efficient state for the transmission of signals.

DOUGLAS GALTON, F.R.S. C. F. VARLEY.
C. WHEATSTONE, F.R.S. LATIMER CLARK.
W. FAIRBAIRN, F.R.S. EDWIN CLARK.
G. P. BIDDER, F.R.S. G. SAWARD.

The Company in the meantime secured the valuable services of Professor Thomson and C. F. Varley, Esq., to guide them in the construction of a core capable of transmitting the requisite number of messages to render the undertaking a remunerative one; the result of those gentlemen's investigations are given in the following communications addressed to Mr. Cyrus W. Field:—

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.

(Incorporated 1846.)

Telegraph-street, London, E.C., July 1st, 1863.

My dear Sir,—I have, during your absence in America, completed the apparatus contemplated at the time of your departure last December, and have tested them on various lengths of submarine lines. Enough has been ascertained to leave no doubt that we shall be able to telegraph through an Atlantic cable direct from Ireland to Newfoundland at the speeds given in the annexed table, depending upon the size of the copper conductor, the weight of gutta percha, and the length of circuit. The speeds indicated in this table might be much increased by a proper system of coding.

I am, my dear Sir, yours very truly,

(Signed CROMWELL FLEETWOOD VARLEY.

From my experience on the old Atlantic cable, both before and after its submersion, and during the time it was being laid, and from estimates founded on the general theory, of which I have shown the principles in papers published in the proceedings of the Royal Society, I feel perfect confidence that the speeds stated by Mr. Varley in the preceding letter are attainable with the general European Morse Telegraphic Alphabet. I have no doubt that considerably higher speeds may be practically realised by adopting some system better adapted to meet the peculiar circumstances of a great submarine telegraph.

(Signed) WILLIAM THOMSON.

To the above communication is added the following interesting Table:—

OPERATION of the Electrical laws affecting the speed of working through long Submarine Cables, exemplified in the weight of insulation in proportion to copper, required to attain given rates of transmission per minute. Ascertained by CROMWELL F. VARLEY, Esq., Electrician to the Electric and International and to the Atlantic Telegraph Companies; and W. THOMSON, Esq., LL.D., F.R.S., Professor of Natural Philosophy in the University of Glasgow.

TABLE,

Showing the speed of working through an Atlantic Cable from Ireland to Newfoundland, a distance of 1,640 *Nautical Miles.*

Allowing 15 *per cent. for slack, will make the actual length of Cable in circuit* 1,880 *Nautical Miles.*

Weight of Copper in lbs. per Nautical Mile.	Weight of Gutta Percha in lbs. per Nautical Mile.	Total Weight of Core per Nautical Mile.	Words per minute through 1,880 Nautical Miles.
107	261	368	3.5
143	224	367	4.
225	275	500	5.8
275	325	600	7.
214	522	736	7.
286	448	734	8.
300	400	700	8.
325	375	700	8.25
350	350	700	8.4
400	400	800	9.5
400	425	825	9.8
400	450	850	10.03
321	783	1104	10.5
450	450	900	10.7
400	475	875	10.25
400	500	900	10.44
429	672	1101	12.
428	1044	1472	14.
572	896	1468	16.

Having ourselves had the honour of assisting in carrying out the important experiments under the Committee of the Board of Trade, we are glad to have this opportunity of expressing our concurrence with the statements which have guided the Atlantic Telegraph Company in their glorious and noble efforts to extend the advantages and benefits of submarine telegraphy, feeling confident that success must be the result.

THE MALTA AND ALEXANDRIA CABLE.

THE obstructions which have deprived the community from time to time of the advantages of telegraphic communication with India, *viâ* Malta and Alexandria cable, have also created a considerable amount of uneasiness and doubt in the public mind, as to the practicability of ever rendering submarine telegraphy a permanent and remunerative institution. This is owing, to a considerable extent, to the absence of information as to the causes of such interruptions, and the reason for the delay which on each occasion has taken place in their removal. We have already, in a previous number, referred to the very unsatisfactory manner in which one of the parties to the lease for working the line have performed their obligations, in not having a vessel always ready at Malta or Alexandria, fitted with the proper appliances for raising and repairing the cable

at once, instead of having to despatch a vessel from England for the purpose. The Council for India have wisely adopted the precaution, in the case of the Persian Gulf cable, of having a steamer, fitted with the necessary machinery, always to be kept in a central and convenient port. Of course such precautions can only be made available for repairing cables submerged in shallow water. All the injuries hitherto, which have occurred to the Malta and Alexandria cable, have been in shallow water, and in localities where the nature of the bottom and the character of the coast were known to have been by no means favourable to the permanency of the cable. The *Malta Times* of the 21st ult., in announcing the interruption of the line, states:—"The injury is supposed to exist not far from Benghasi, on the east side; and it is satisfactory to mention that there is every reason to believe it is of a purely mechanical nature, as the stoppage was quite sudden, and took place, without any previous deterioration or fluctuation of electric force, whilst a message was being sent through the line to Alexandria. Every effort is being made to discover the exact locality of the damage, which, it is considered, very likely to have been caused by some ship's anchor dragging, during the late violent storms on the coast." It is further stated, "that an officer from the station at Benghasi, attended by a proper escort from the Caimakan, had been despatched with instructions to proceed along the shore to see if signs existed of any vessel having been driven on the coast, and, if necessary, to prosecute his researches a hundred miles to the eastward." We find that there were several of Her Majesty's ships at Malta, and no doubt machinery might have been easily placed on board, had there been such machinery in readiness at Malta, or any of the other stations. Admiral Smart, we are informed, was most ready in offering any assistance in his power, but observed that *men of war*, for obvious reasons, were ill adapted for cable ships, and he feared that nothing could be done till the arrival from England of a vessel fitted with all the appliances for the purpose. So that the provisions of the lease, authorising the loan to the lessees of any of Her Majesty's ships which might be at Malta, or at any adjacent port, are utterly useless. We trust that the vessel which has just left England, for the purpose of repairing the injury, will remain at some convenient port, so as to be ready in case of emergency; or that a fresh survey be made, and that those portions of the line which are known to be laid on a rocky and dangerous bottom, be removed to more favourable positions, in which the cable will be less liable to be subjected to mechanical injury, either by attrition, or by being severed by dragging anchors.

SELF HELP.

Sir,—I have read "J. R. O.'s" letter and also your article on "Amenities."

It cannot be wondered at that the continental clerks are more scientific and generally better educated than our own. Read the list of subjects in which candidates are examined, and consider how very few, even of the sons of wealthy men, could pass such an examination. The reason is that science, being required, is more cultivated abroad, and that, owing to the comparative scarcity of employment and the lower scale of expenditure in living, young men of superior birth and station are content with low salaries.

Were continental salaries given, and continental acquirements expected here, how many of our circuits would be manned?

But when it comes to *work*, we can fearlessly assert that our own staff is far more energetic and does its work far better than those across the water. Not because they are *not scientific*, but because they are more persevering and business-like; because they are, in fact, English.

"J. R. O." is mistaken when he says telegraph clerks have neither books nor encouragement; but he is more mistaken if he thinks *encouragement*, or the giving formal instruction, will make good men out of bad ones.

Every one must help himself; all our great men have made themselves and ever will. When a clerk or workman shows a desire to improve and exhibits talent, I will take upon me to say that there is no superior officer in the whole service who will not be but too glad to answer his questions and bring him forward. For why? good men are scarce and are urgently wanted. All our best clerks, with few exceptions, have been messengers, while the most useless and troublesome fellows on the staff are those who have influential friends and who bring a packet of testimonials. Why so? Instead of trusting to themselves, these last lean on what their *friends will do for them*, and rely on the influence they can bring to bear to screen their defects.

Our clerks' hours of duty, even at the longest, are far less than those of persons of similar rank engaged in trade. The genius of their employment, unlike that of the shop, leads to and encourages self-improvement, while, in fact, very many have time enough, and to spare, during their hours of duty to improve themselves. But what is too often the case, the clerk who has eight or nine hours of leisure, during which he is obliged, however, to remain in his office, and is almost driven to study even to pass the time; this man is always inaccurate and behindhand in his returns and accounts—has never *time*, he says, even to give the slight items of information for which he is occasionally called upon.

Other men, hard worked fourteen or more hours a-day, *make time* for self-improvement. Where there is a will there is a way.

I have been induced to offer these few remarks to my fellow telegraphists by reading the report of a presentation of a service of plate, worth between four and five hundred pounds, to a late chairman of a railway company on his retirement.

He is the son of a working man—his schooling, such as it was, finished at his eleventh year; he then earned a living as he could till he was seventeen, was then apprenticed to a carpenter and for some time worked at his trade. This gentleman not only has made his fortune—not by speculation but by steady industry—but has also educated himself and *made time* to write some twenty volumes on learned and difficult subjects.

Let our young friends look round and see if they can name *any one* whose rise has been brought about by what others have done for him, by his being "coached" or "crammed" with electrical or technical knowledge.

There is no royal road to learning or to success; it must be fought for and won by individual energy, perseverance, and contempt of difficulties. How many "impossibilities" have been overcome in a moment when an order has been issued that the impossible thing *must be done*.—Yours,

AMICUS.

THE LAST TELEGRAPHIC FEAT.

In our last number, under the above heading, we inserted a few interesting particulars relating to the transmission of the speeches of the honourable members for Birmingham, from that town, by telegraph, to the metropolis. For some days the "coming event" had been a subject of much speculative discourse in all the great telegraph and newspaper establishments of the metropolis, especially as it was believed that the speech of Mr. Bright would not only be a lengthy one, but that there would be a tilt against the *Thunderer* of Printing-house-square; and in this, at all events, they were not disappointed. We have stated that the speeches contained no less than 49,000 letters, and that the whole were transmitted to London, and delivered at the offices of seven newspapers before 3 o'clock, A.M.; the whole operation in London being super-

intended by Mr. Boys, the Chief of the Intelligence Department of the Electric and International Telegraph Company, and at Birmingham by Mr. Wade. The difficulty experienced in reading the reporter's copy; the care and labour involved in the transmission itself; the copying out in London, and the collection of the slips coming by the different wires; and the supervision necessary before the copy is delivered into the hands of the messengers of the fourth estate, create in the telegraph room no inconsiderable amount of bustle and excitement, on the night when the great politicians of the north are displaying their oratorical powers before their admiring and enraptured constituents. Our readers will better understand the enormous amount of labour required of the officers in charge and the manipulators, on such an occasion, when they glance over the alphabetical code employed in the transmission of intelligence with the Morse instrument, which we append. Every *dot* and *dash* require a distinct operation. The *dot* is effected by a quick tap on the key, and the *dash* by a slow one. Any of our readers may be able, after a short practice with their hands upon a table, to converse by such means with great rapidity.

The great advantage offered by recording telegraph instruments over needle and dial instruments is, that they impress, or print, on continuous paper strips, clear and distinct marks, representing the messages transmitted, whereas the latter only produce transitory signs, subject to misinterpretation and omissions.

ALPHABETICAL CODE FOR THE MORSE INSTRUMENTS.

I. Alphabet.

Letter.	Sign.	Letter.	Sign.	Letter.	Sign.
A	. —	J	. — — —	S	. . .
B	— . . .	K	— . —	T	—
C	— . — .	L	. — . .	U	. . —
D	— . .	M	— —	V	. . . —
E	.	N	— .	W	. — —
F	. . — .	O	— — —	X	— . . —
G	— — .	P	. — — .	Y	— . — —
H	. . . .	Q	— — . —	Z	— — . .
I	. .	R	. — .	Ch	— — — —

II. Ciphers.

Cipher.	Sign.	Cipher.	Sign.	Cipher.	Sign.
1	. — — — —	5	. . . . .	9	— — — — .
2	. . — — —	6	—	0	— — — — —
3	. . . — —	7	— — . . .		
4	. . . . —	8	— — — . .		

III. Punctuations, &c.

		Sign.			Sign.
Full stop	.	. . . . . .	Apostrophe	'	. — — — — .
Colon	:	— — — . . .	Line of fraction	$\frac{11}{23}$	— — — — — —
Semicolon	;	— . — . — .	*Inverted commas	" "	. — . . — .
Comma	,	. — . — . —	*Parenthesis	( )	— . — — . —
Interrogation	?	. . — — . .	*Sign for underscoring		. . — — . —
Exclamation	!	— — . . — —			
Hyphen	-	— . . . . —			

* To be placed before and after the respective signs.

IV. Official Signs.

	Sign.		Sign.
Public message	. . .	Understood	. . . — .
Official Telegraph message	. —	Interruption	. . . .
Private message	. — — .	Conclusion	. — . . — . . — .
Call signal	— . — . — . —	Wait	. — . . .
		Receipt	. — . . — . . — . — .

The length of a dot being taken as a unit, the lengths of the different signs will be as follows:—

A dash = 3 dots.
The space between the signs of a letter = 1 dot.
" two letters = 3 dots.
" two words = 6 dots.

SUBMARINE CABLES.

I.

THE more the causes which have led to so many disastrous failures in submarine telegraphy are sifted and inquired into, the stronger becomes the conviction that the old and favourite plan of strengthening and protecting our cables with iron, exposed to the corrosive action of sea water, is utterly inadequate for the object in view. In fact, experience has proved that to envelope our cores in naked iron is to lessen rather than to increase their permanency. It is remarkable that, until lately, this prolific source of danger to cables has received, comparatively speaking, but little or no consideration; that while a vast amount of ingenuity has been expended upon the construction of instruments, in investigating the laws which govern the transmission of the electric current (with a display of mathematical lore which has seldom or ever been paralleled), and in the preparation and manufacture of the best insulating material, &c., very little attention has been paid to the external requirements of our cables.

In almost all the cables hitherto submerged—with the exception of the Isle of Man and South of Ireland cables, and the Persian Gulf cable, now about to be laid—the insulating cores have been sheathed with iron wires; and in the numerous attempts which have been made from time to time to repair or recover cables which had failed, it was found that the iron wires had been completely eaten away by corrosion, and the insulator damaged in some cases by the sharp points of the severed wires, and by attrition, &c. Mr. Latimer Clark, in his report to the directors of the Red Sea Telegraph Company, states:—"The electrical condition of the copper and gutta-percha core was generally so good, that when properly covered it is fit for resubmersion; but, owing to the entire absence of all protection, the iron was corroded away; that the cable, when suspended over rocks or submarine valleys, gave way spontaneously, breaking up in short lengths." The evidence of other experienced telegraph engineers may be adduced confirmatory of the inapplicability of unprotected iron sheathing in both shallow and deep water.

We have carefully perused the voluminous evidence given before the Government committee, consisting of some 5,000 questions and answers, occupying no less than 280 folio pages. No less than 44 witnesses were examined, yet the danger from the corrosion of the iron sheathing had been foreseen but by few. We place before our readers some of the statements as they appear in evidence.

The late Mr. J. W. Brett, in answer to Mr. Saward, secretary to the Atlantic Telegraph Company, states, with respect to the Dover and Calais cable, which had been recently taken up to be repaired:—"In some parts the iron is very much corroded where it has come in contact with the lime and the chalk rocks." Mr. Canning, who had examined the same cable, adds:—"In many places the outside wires appear to be very bad indeed, and eaten away, but to a very small extent in others; it is very much rusted, and, in fact, so much so, that there is a very small portion of wire holding or remaining." Mr. W. H. Preece, engineer to the Channel Island Telegraph Company, mentions also "several instances of corrosive action having impaired the iron sheathing of the company's lines," and adds:—"Perhaps you would allow me to observe, in speaking of corrosion of cables, that I am decidedly of opinion that no cable should ever be submerged upon a rocky bottom, or upon a bottom likely to be swept by tides, without having some exterior shield to protect the iron from this corrosive action." Mr. R. S. Newall says:—"From our experience in laying the Red Sea cables, and finding that the iron wire is completely corroded off it in various places, I think that it is worse than useless putting it in any water except shallow water, and near the shore, to guard against ships' anchors. We found the same thing occur in the Holyhead cable, that the iron wires were completely corroded off it." Mr. F. C. Webb, who has had considerable experience in the laying and repairing of submarine cables, in a paper read by him before the Institution of Engineers, gives the following as the result of his experience:—"When the cable was buried it was found to be in perfect preservation, the galvanised surface being as clean and good as when the cable was first laid; whilst in those places where it lay on the surface it was eaten through, extending in many parts for one or two feet in length, to such an extent that it was only held together by a portion of only one outside wire. The gutta-percha and hemp were undisturbed, retaining the impression of the outer wires, thus showing that the decay was not caused by mechanical injury, but by oxydization,

probably the result of galvanic action. The galvanised surface had also entirely disappeared where the cable was not buried. This decay, where the cable lay on the surface, fully accounted for the invariable fracture of the cable seaward of the ship when it was grappled for and lifted outside the bank." And again, Mr. Webb, in his evidence before the Government committee, states:—"In some places the outer wires are much eaten by rust, and at such places a very slight strain would break them. I have seen places on the rough grounds where the outer covering was completely eaten through for a few inches, whilst a few yards off from the same spot the cable was quite sound and strong."

Mr. C. F. Varley, in his report of his efforts to recover a portion of the Atlantic cable on the coast of Newfoundland, states:—"The recovered cable varied in condition very much, and what is most important is, that even those portions which came out of the black mud were so perished in numerous patches, that the outward covering parted on board during the process of hauling in." In fact, it has been found that in all attempts made to recover or repair iron-sheathed cables, whether in the Red Sea, the Mediterranean, or the Atlantic, the corrosive action of the water has in every instance, to a more or less extent, impaired the strength of the cable.

THE VICISSITUDES OF A TELEGRAPHIC ENTERPRISE.

In order to ensure the success of any great national undertaking, to develope any new enterprise, or to establish any discovery tending to the public weal, it appears necessary that a sacrifice should be offered to propitiate the Fates. No grand work has ever been accomplished without disasters having occurred in the outset of the most discouraging character. When Stephenson first ran his engine upon the Liverpool and Manchester line, nothing less than the mutilation of one of his best friends would suffice to inaugurate the new era in locomotion The reverses which Brunel met with in his "Leviathian" project are still fresh in the memories of most of our readers; and it will not be out of place here, just to revert to the calamities which befel the Atlantic cable in 1858, whereby half a million of public money was sunk in the bed of the ocean, and confidence in the practicability of submarine telegraphy shaken to its foundation.

We extract the following interesting particulars from a very ably written paper on "The Atlantic Cable and its Teachings," by Mr. W. Crookes, which appears in the *Quarterly Journal of Science*:—*

A great amount of misconception prevails respecting the now defunct Atlantic cable, and we propose to disinter from the ponderous official documents some portions of its history which are not generally known.

The "Niagara" and "Agamemnon" having met and joined their respective halves of the cable in the middle of the Atlantic, started thence and proceeded, one to Newfoundland, the other to Valencia Bay, in Ireland, electrical signals being constantly passed from one ship to the other. At one point, when nearly 400 miles had been paid from each ship, the electrical signals became very weak, and the tests applied by the electrician on board the "Agamemnon," showed that there was defective insulation at a very remote part of the cable. The fault then seemed to get better, and in about an hour the cable tested as usual. Three days afterwards, when about 560 miles had been paid out from each vessel, considerable irregularities were observed, the signals becoming weaker, until it was reported from the electrical cabin that they had ceased altogether. They shortly afterwards returned, and gradually improved for some hours, when they became as strong as ever. In fact, on the evening of this day (August 2), the signals from the "Niagara" were reported to be stronger than they had been previously. Other irregularities in transmission were afterwards observed, but the general working of the cable seemed good, and on referring to the memoranda taken by the electricians at the time, we find the signals spoken of as "good" in the morning of the 3rd August, "first rate" about the middle of the day, and "perfect" in the evening. The next day we have reports of constant signals from one ship to the other, and the memorandum "all right," is repeated several times. On the 5th of August, at 2.10 A.M., the "Niagara" signalled that she had paid out 1000 miles of cable, and at 3.50 A.M., the "Agamemnon" had paid out the same quantity. At that time, intelligible signals were passing through the 2000 miles of cable, from one end to the other, and in a few hours each ship was safely at anchor. Thus, then, the possibility of connecting the two continents by an electric cable was proved.

* John Churchill & Sons, New Burlington-street.

On the 10th of August, the first words were sent from America to Ireland, but although the whole day was occupied in such messages as "Repeat, please," "Please send slower for the present," "How do you receive?" "Please say if you can read this," "How are signals?" "Please send something;" and the second day was occupied in similar messages and requests to "Send alphabet," and "Send V slowly," Valencia, like a coy maiden, refused to respond to these entreaties. On the third day, Valencia showed signs of thawing, and condescended to obey the request contained in the following message sent from America:—"If this received, send battery current in one direction five minutes." The next day when America signalled—"Send word Atlantic," Valencia was able to reply, "Atlantic:" (this was the first word read in America.) We then find several words from Valencia in answer to American entreaties, but during the whole of this day, America was signalling to Valencia such messages as these:—"We receive currents, but can't read you," "Can't read," "You must send slower, as some of your dots do not show on most delicate detectors," "We get your currents, but so irregularly, that we cannot read them; will you examine your key well?" On the fifth day, Valencia thawed a little more, and actually asked America to "Send faster;" but although several long messages were sent on that day from America, only isolated words were received in reply. On the seventh day, Valencia and America seem to have arrived at a better understanding with each other, and Valencia asked, "Can you take a message?" with the warning, "You must repeat each sentence in full." Upon receiving an affirmative reply, Valencia telegraphed:—"Directors of Atlantic Telegraph Company, Great Britain, to Directors in America: Europe and America are united by telegraph. 'Glory to God in the highest; on earth peace, good-will towards men.' Repeat back faster. Queen's next." After America had telegraphed back the above message, the Queen's message was sent. This consisted of ninety-nine words, and occupied altogether sixteen hours in its transmission; many parts were repeated over and over again, and the whole message was signalled back to ensure accuracy. After this, owing to the greater delicacy in the reading instruments, and especially to Professor Thomson's beautiful reflecting galvanometer, several long messages were sent backwards and forwards; America, however, always doing the greater part of the talking. On the tenth day very good signals came, and Valencia asked for the messages to be sent faster. The telegram respecting the collision between the "Arabia" and "Europe," was sent on that day from America, and it was followed by the President's message to the Queen.

Professor Thomson was at this time constantly engaged upon experiments, and the result of these was that the cable spoke much more intelligibly, complimentary messages being sent between the directors and many public men, and several long directions on the details of working the instruments. From this time the cable seemed to improve, and on the twenty-second day the memorable Government messages were sent to America, countermanding the return of the 62nd and 39th Regiments, thereby saving to the British Government the sum of £50,000.

On the 30th of August, Mr. Field telegraphed from America, as follows:—"Early in the morning of September 1, Please send me message that I can read at the celebration that day, and another on the 2nd that I can read at dinner that evening." Accordingly on the 1st of September, Valencia telegraphed the following message to C. W. Field, New York:—"The Directors are on their way to Valencia, to make arrangements for opening wire to public. They convey through cable to you and your fellow-citizens their hearty congratulations and good wishes, and cordially sympathize in your joyous celebration of the great international work."

Up to this time the condition of the line may be said to have undergone slight improvement. Several long and important communications had been sent through it, and it was on the eve of being formally opened for commercial purposes, when, without any ascertained cause, a collapse took place, and the Atlantic Telegraph suddenly became defunct; its death being the more ignominious when we take into account the message, in the utterance of which it expired. From this date no other sentence could be forced through, and with the exception of isolated words and signals during the month of September, all attempts to restore communication failed. As late indeed as October 20th, eight words of a sentence were spoken through the cable from Newfoundland to Valencia, but this was owing to the employment of recklessly energetic battery power, and may be looked upon as the spasmodic twitchings of a galvanized corpse, rather than healthy vitality.

The Atlantic Telegraph project is again attracting public attention. Mr. Cyrus W. Field (one of the leading spirits of the undertaking) is again amongst us, full of hope, and ready to embark once more in the gigantic enterprise. We have learned many lessons of wisdom by the last sad failure; and it is confidently believed by those who have the best means of judging, that the renewed efforts about to be made to unite the old and new world will be attended with perfect success.

The Coming Man.—The *New York Tribune* states that a telegram was recently despatched to the Federal army, directing to whom the command of a brigade was to be intrusted, and that the operator at the telegraph station declared the person selected to be Amjyrdkowasejcw Dcabxpcop.

THE INTERNATIONAL EXHIBITION, 1862.

(*Continued from p.* 53.)

TABLE C.—PART II.—CABLES WHICH HAVE BEEN SUCCESSFUL FOR SOME TIME, BUT ARE NOT NOW WORKING.—*October*, 1862.

No.*	Date when laid.	FROM	To	Conductors. No.	Conductors. Size per B.W.G.	Size of Insulator per B.W.G.	Outside Wires. No.	Outside Wires. Size.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Maximum depth of Water in Fathoms.	Weight in Tons per Statute Mile.	Length of time the Cables have worked.	OBSERVATIONS, AND PROBABLE CAUSES OF ULTIMATE FAILURE.
1	1850	Dover	Calais	1 wire.	—	—	None	None	About 25	25	30	—	1 day.	No protection of any kind: is called a partial success because it established the possibility of telegraphic communication between England and France.
2 2a 2b	1853 to 1855	England . . . (Three similar Cables)	Holland . .	1 do.	16	1	10	8	360 Aggregate.	360	30	2	5 to 6 yrs.	So frequently broken by anchors that it was found cheaper to recover these cables altogether, and replace them by a very strong cable, No. 20 in list, part I. One of these cables was relaid between Holyhead and Howth, when No. 3 cable in this list was abandoned.
3	1854	Holyhead . . .	Howth. . . .	1 do.	16	0	10	8	75	75	70	2	5 years.	Iron wires rusted so much after five years as not to admit of repairs at moderate cost.
4	1855	Varna	Balaclava. . .	1 do.	16	2	None	None	355	355	300	0·1	9 months.	Cause of failure not known. The only unprotected cable, or insulated wire, successful for any time.
5	1855	Balaclava . . .	Eupatoria. . .	1 do.	16	2	12	18	—	1				
6	1857	Varna	Constantinople .	1 do.	16	2	12	?18	170	170	Shallow	0·75	4 or 5 yrs.	Too light for shallow water.
7	1857	Sardinia	Bona	4 strands.	16	5	18	11	150	600	1500	1·85	3 years.	Not tested under water; iron wires quite rusted off in some places; 80 miles recovered.
8	1857	Sardinia	Corfu, *viâ* Malta	1 strand.	15	1	18	15	700	700	1000	0·9	1 year to 18 mths.	Not tested under water, after being covered with iron; cause of failure not known.
9	1858	England. . . .	Channel Islands	1 do.	14	1	9	6	102	102	60	2·5	2½ years.	Too light for position in which laid; strong tides, rocky bottom; repaired eleven times, and abandoned, owing to cost of repairs.
10	1858	Ireland (Atlantic)	Newfoundland .	1 do.	14	00	126, *i.e.* 18 strands of 7, No. 22, wires.	14	About 3000	About 3000	2400	1·0	3 weeks & 4 days	Not tested under water; probably faulty before laid; outer covering soon rusted. The 3,000 miles includes cable lost in 1857. Copper 93 lbs., gutta-percha 227 lbs. per mile.
11	1859	Singapore . . .	Batavia . . .	1 do.	12	0	18	16	630	630	20	0·94	About 2 years.	Too light; was continually broken by anchors, or maliciously by natives; frequently repaired.
12	1859 1860	Suez (Red Sea and India)	Kurrachee . .	1 do.	12	0	18	16	3500	3500	1910	0·94	6 to 9 months each section.	Five sections. Not tested under water after being covered; outer covering soon rusted through. Never good at one time from end to end. Copper 156 lbs., gutta-percha 184 lbs. per mile. Four miles of wire, insulated with india-rubber, laid at Kurrachee, were found to be totally decayed in 1862. The gutta-percha, whereever examined, was sound.
13	1859	Spain . . .	Africa (Ceuta) .	1 do.	14	00	126	14	25	25	—	1·0	Not known.	
14	1859	England . . .	Isle of Man . .	1 do.	16	2	10	6½	36	36	30	2·5	3 years.	The first cable in which the outer iron wires were protected against rust by hemp and bitumen; temporarily broken; will probably be repaired.
15	1859	South Australia .	Tasmania. . .	1 do.	16	1	10	8	100	100	60	2	—	Same cable as No. 35, part I. Chafed by rocks, and found difficult to repair, owing to nature of ground, and probably to the absence of proper appliances.
16†	1859	Liverpool . . .	Holyhead. . .	2 strands.	16	3	12	6	25	50	14	3·1	—	Broken by ships' anchors continually.
17	1859	Syra	Candia. . . .	1 strand.	14	1	16	15	150	150	—	0·89	2 to 3 yrs.	Has been abandoned and picked up, because it did not pay for the repairs required. A hemp cable was temporarily tried on this line.
18	—	Across Mersey. .	—	—	—	—	—	—	3	3	—	—	12 months	About three miles of cable, with wires insulated by india-rubber, were laid across the Mersey, and between various docks. This cable was removed, owing to constant accidents. The india-rubber is said to have remained perfect.
				Totals					9406	9882	These totals can only be taken as approximations, as the exact length of several of the cables is not accurately known.			

* The numbers do not represent the exact order in which the cables were laid, and are only given for convenient reference.

† Some part of this cable is again at work.

TABLE C.—PART III.—TOTAL FAILURES.

No.	Date when laid.	FROM	To	Conductors. No.	Conductors. Size per B.W.G.	Size of Insulator per B.W.G.	Outside Wires. No.	Outside Wires. Size.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Maximum depth of Water in Fathoms.	Weight in Tons per Statute Mile.	Length of time the Cables have worked.	Observations, and Probable Causes of Ultimate Failure.
1	1852	Holyhead . . .	Howth. . . .	1 wire.	16	—	10	1	75	75	70	0·45	—	Hemp or jute rope in three strands; no iron; india-rubber next copper, covered with gutta-percha.
2	1852	Portpatrick . .	Donaghadee . .	2 wires.	16	8½	None	—	17	84	160	—	—	Faulty insulation. This cable was all recovered.
3	1852	Portpatrick . .	Donaghadee . .	5 do.	16	2	12	2	15	75	160	4·8	—	Cut away after this length had been paid out. Subsequently recovered.
4	1854	Holyhead . . .	Howth. . . .	1 wire.	16	0	10	8	65	65	70	2	2 days.	
5	1855	Sardinia. . . .	Africa	6 wires.	16	1	12	1	40 to 50	240 to 300	About 800	8 to 7½	—	The vessel laying this cable was taken out of her course by a French steamer, and the length was consequently insufficient. A considerable portion was subsequently recovered.
6	1855	Cape Ray . . .	Cape North . .	3 do.	16	2	10	4	30	90	360	—	—	A sailing vessel towed by a steamer was used in the attempt to lay this cable. Bad weather came on, and the cable was cut to save the ship.
7	1855	Sardinia. . . .	Africa	3 do.	17	4	10	8½	About 160	480	1500	8·7	—	
8	1859	Candia	Alexandria . . .	1 strand.	13	1	18	16½	Say 150	Say 150	1600	0·89	—	Several unsuccessful attempts were made to lay this cable—once with a hemp cable, which failed from a defect in insulation (not tested under water); again with a light iron-covered cable, broken accidentally. The length of insulated wire lost is not known.
				Totals					557	1239	These totals are very rough approximations.			

NOTE.—The writer is much indebted to the French, Spanish, and Swedish Governments, to Sir Charles Bright, Mr. Latimer Clark, and Mr. Cromwell Varley, as well as to the Exhibitors, for the assistance given him in compiling table C. He regrets to feel that many additions and corrections might still be made.

Comparative Table of Inches and Numbers in Birmingham Wire Gauge.

Birmingham Wire Gauge.	0000	000	00	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Inches in Diameter . . .	·454	·425	·380	·340	·300	·284	259	·238	·220	·203	·180	·165	·148	·134	·120	·109	·095	·083	·072	·065
Birmingham Wire Gauge.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Inches in Diameter . . .	·058	·049	·042	035	·032	·028	·025	·022	·020	·018	·016	·014	·013	·012	·010	·009	·008	·007	·005	·004

2. *Unsuccessful Cables, and Causes of Failure.*

Hitherto successful cables only have been spoken of; but the great extension and success of submarine cables has been accompanied by some great failures. A cable successfully laid across the Atlantic in 1858 worked for three weeks, and then failed altogether; a specimen of this well-known cable is exhibited by Mr. Brett.

A cable laid from Suez to Aden worked for nine months, and then failed a few days before a second section was completed from Aden to India. At the present time all this cable is useless, except a short piece from Suez to Jubal.

A specimen of the core of this cable is shown by the Gutta-Percha Company, and the Dacca-Pegu cable exhibited by Mr. Henley exactly resembles the outer covering. A similar cable was used to join Singapore and Batavia; this has been repeatedly broken, but being in shallow water, has been from time to time repaired. Malta and Corfu, and Malta and Cagliari were for many months connected by a very similar cable, the core of which is exhibited by the Gutta-Percha Company, and various other lines, successful at first, have now been totally abandoned. Not one of these cables was tested under water after manufacture, and every one of them was covered with a sheathing of light iron wires weighing in the aggregate only about 15 cwt. per mile.

These two peculiarities are amply sufficient to account for any failure which has hitherto occurred. In fact no electrical test will show the presence of flaws in the insulating cover of a wire unless water or some other conductor enters these flaws, and establishes an electrical connection between the outside and the inside of the cable. It is not surprising that a few flaws are always to be found in every long cable. It cannot be expected that hundreds of miles of a thin soft covering shall either be made perfect in the first instance, or remain uninjured while being covered with iron wire.

Whenever, therefore, a long cable has been submerged without having been previously tested under water, defects have generally been detected shortly after submergence; these defects, holes, or flaws have then been too often subjected to the action of powerful batteries, which by the heat and chemical action they develop, enlarge the fault, and cause the gradual but sure destruction of the cable. The other cause of failure named, viz., the small size of the wires used to cover the unsuccessful cables, is curiously connected with the omission of the necessary test under water. Engineers were afraid to keep these cables under water during manufacture lest the light iron wires should be weakened by rust, and break during submergence. They were kept dry, and in almost every instance the cables were submerged safely, and as it was thought successfully. It was supposed that after submergence the iron wires might rust away without danger to the core. Precisely the contrary has occurred; so long as the iron wires lasted the cables frequently continued to work in spite of faults in the insulating cover, but sooner or later the iron wires of all these light cables rusted away in parts, and as soon as this took place they one and all broke up into short sections. This fact has been observed in the Atlantic, the Black Sea, the Red Sea, and the Mediterranean, in shallow water, and in depths of 1,000 fathoms. The wire does not rust uniformly off the cable, but is eaten completely off at certain points, and here the gutta-percha and copper frequently sever. Engineers are not agreed as to the cause of these fractures; some think the cables have have been laid in a state of tension, so that they contract when the outer wires yield at any point; others suppose that the cables are, as it were, festooned from ridge to ridge along the bottom, but neither explanation seems to the writer fully to account for the universal occurrence of this phenomenon, which is worthy of further examination. Meanwhile, the use of large iron wires seems a sure guarantee against this danger, for as yet no cable covered with wire of the large gauges has ever parted in the manner described.

As an additional security several cables have, as already mentioned, been protected by a bituminous covering. It is hardly necessary to add that no engineer now thinks of allowing a cable to be laid which has not been constantly and carefully tested under water.

There are now more than 5,000 statute miles of cable, containing more than 9,000 miles of insulated wire, in successful operation. By far the greater portion lies in depths of less than 100 fathoms, and it may be safely said, that no improvement in design is required for these shallow-water cables.

3. *New Forms proposed for Deep-Sea Cables.*

It cannot yet be said that the problem of the best form for long deep-sea cables is successfully solved.

Some of these cables have certainly been successful, but many have entirely failed, chiefly owing to the causes already mentioned. The remedy of heavy iron wires is hardly applicable to this case, owing to the great weight, cost, and risk they entail. Many new forms have consequently been proposed for use in deep sea, but many of them are founded on a misconception of the defects of the usual type. The difficulty of laying the common cable in deep water has been much exaggerated; very few cables have broken during submergence, and of those few, most have been broken by accidents such as might occur with any form of cable.

The usual cable can be laid with ease in any depths less than 1,000 fathoms, and can with equal ease be recovered from those depths so long as the outer wires remain sound. The danger of kinking has also been much over-stated: with proper appliances cables very seldom kink, and not one kink in a hundred does any harm. If small iron or steel wires could be efficiently protected against rust, there would be little fault to find with the common type of cable.

The Gutta-Percha Company, M. (United Kingdom, 3,000), show an excellent but expensive specimen in which each iron wire, or rather strand, is protected by gutta-percha.

W. Hooper, H. M. (United Kingdom, 2,915), shows specimens in which hard vulcanized india-rubber is used for the same purpose, and also a specimen in which the aggregate iron sheath is cased in a cylinder of vulcanite; this latter form entails the use of his preparation of india-rubber as an insulator.

T. Allan, M. (United Kingdom, 2,860) proposes to surround a solid copper conductor with the steel wires, and to cover the whole with gutta-percha as an insulator in the usual way, dispensing with the outer iron wires altogether, but using instead a canvas serving saturated with marine glue and asphalte.

He thus obtains a light cable which will support upwards of 7,000 fathoms of its own length in water. Looked upon as an electrical instrument, such a cable would be inferior to a similar copper strand equal in weight to his combined strand, and covered with an equal quantity of gutta-percha; but this inferiority could be made up by an increase in the weights of the materials, and the combined strand is so proportioned as to reduce the inferiority as much as possible. Mr. Allan's cable, on the other hand, is certainly less liable to be broken or injured by stretching than a mere insulated copper strand would be. It is generally thought unsafe to leave the outer surface of the insulator so unprotected as Mr. Allan proposes, and it is to be feared that the two dissimilar metals inside the sheath might lead to injurious chemical action. It is to be regretted that Mr. Allan's cable has never been practically tested. If the steel wire could be obtained in sufficient quantities, Mr. Allan's would be cheaper and lighter than the usual cables.

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit specimens of a submarine cable intended chiefly for use in deep water, and described by them as follows:—

"The insulator is covered with a double layer of hemp-strings of the strongest material, saturated in Stockholm tar, laid on spirally and under considerable tension, the twist of the two layers running in opposite directions. It is finally covered by a flexible brass or copper sheathing composed of bands of sheet copper or brass, put on spirally under the influence of great pressure, and with each succeeding turn overlapping the

preceding. The covering thus produced resembles the scales of a fish, affording perfect protection without being deficient in flexibility."

Messrs. Siemens further say that the phosphoretted copper or brass used will not corrode in sea water, but remain in perfect condition for a great number of years, and that the tensile strength and low specific gravity of the cable will, together with its durability, allow the cable to be lifted in very great depths, and after the expiration of many years. Messrs. Siemens have certainly produced a light strong cable, not liable to kink, easily handled, and affording fair lateral protection. It stretches less than one-half per cent. with half its breaking strain, and a cable only ⅜ in. diameter will not break with less than fifteen cwt. The cable could therefore be easily and safely submerged. It is, however, doubtful whether Messrs. Siemens' opinion as to the durability of the sheathing can be justified. It is found very difficult to obtain any two specimens of copper or brass, of similar electrical properties; and any equality of composition between the various bands of metal used, which cause galvanic action to be set up, resulting in the rapid decay of some parts at least of the thin metal protection. The hemp, if left unprotected by metal, would rapidly decay or be eaten by animals, and the cable in this state would be in the very same conditions as have proved so fatal to cables covered with light iron wires.

Experience may prove that these fears are unfounded, and Messrs. Siemens state that they have for some months past kept samples made with strips of various coppers in sulphuric acid and water without producing any destructive galvanic action. Most engineers will probably agree in wishing that this novel form of cable should be tried, although they may not be prepared to accept the responsibility of recommending its adoption.

This form of cable seems well adapted for various uses on land—as for military lines, electric target wires, mines, &c. The cost of the covering is about the same as that of a light iron wire sheathing, but the new form is much lighter and more easily handled.

(*To be continued.*)

PRIVATE TELEGRAPHS.

Many schemes have been devised, from time to time, for relieving large towns of the inconveniences arising from the increase of vehicular and passenger traffic, consequent upon the development of trade and commerce; and among them the telegraph is not the least important. The city of London has completely outgrown itself, and every means must be adopted to lessen the difficulties encountered in the overcrowded streets of the metropolis. We have subterranean railways, pneumatic despatch companies, and a telegraph network employed to attain this end, but until the public take advantage of the means thus placed at its disposal, very little improvement can be anticipated. A prejudice still exists against the adoption of the telegraph, by private firms, which we shall endeavour to remove, by pointing out the advantages which would result from its more general employment.

Business in large establishments is frequently subject to considerable delay, in consequence of the difficulty experienced in communication with branch offices, by special messenger, or through the post. The pecuniary loss thus incurred can only be estimated by contrasting the working of the telegraph with the now old-fashioned system of porterage.

The Houses of Parliament, the Government offices, the police and fire brigade stations of the metropolis, are all united by the wire—and in this particular instance we note a degree of sagacity manifested by our public functionaries, excelling the acumen displayed by some of our most spirited capitalists, who are generally the first to adopt any great improvement or application—money market operations are flashed to and from all the cities of the United Kingdom; and, indeed, the telegraph has become indispensable in our commercial relations. In several instances manufacturers have connected their various factories with their city offices by a private line of telegraph, and are thus enabled to give orders for the execution of work immediately on receiving instructions from their customers, a desideratum especially commendable to all persons engaged in extensive mercantile enterprises. No difficulties are experienced, no errors occur (but such as can be rectified in an instant). The beautiful instruments of different inventors, employed in this branch of telegraphy, are easy of manipulation, and may be worked by any clerk, foreman, or youth of ordinary intelligence. Notwithstanding these recommendations the telegraph has not been made subservient to the requirements of city men to any considerable extent. By the old method it becomes necessary to write out orders and to dispatch them by a porter, who, travelling by the quickest route, is often unable to reach his destination under several hours, involving no small loss of time, and incurring great expense.

Now, what has been done by the aid of the telegraph, in the instances above enumerated, we would urge upon the favourable consideration of all firms having depôts remote from the central office. Contractors for the execution of works in any part of the metropolis would find the telegraph a most valuable adjunct to their staff, and we venture to affirm that its employment generally for intercommunication would diminish the inconveniences inseparable from a voluminous correspondence, avoid disappointment consequent upon many a fruitless journey, and admit of a reduction in the working expenses of large establishments.

One great objection to the adoption of the telegraph by individuals is the first cost; but this does not avail in London, for wires may be rented of the various companies from £2 per mile per annum; and any one can, therefore, have his exclusive line for a comparatively trifling amount. Persons engaged in trade will thus be enabled to form a tolerably correct estimate of the outlay that would be necessary to connect their various places of business by the telegraph; and we hope that many, who have hitherto ignored the private line on account of its expense, will be led to acknowledge its immense utility, and to avail themselves of one of the most effective means of relieving large towns of superabundant traffic.

NEW PROCESS OF ELECTRO-DEPOSITION.

We have great satisfaction in announcing to our readers the success of a most important invention, consisting of improvements in the art of silver plating and gilding by electro-deposition by means of new apparatus, the invention of Mr. S. Moore, of 34, Liverpool-street, Bishopsgate-street, and for which he has obtained Her Majesty's Royal Letters Patent.

The great demand which has of late years arisen for this class of goods, and the advantages which the public have derived from their use, are ample reasons for the attraction of the notice of scientific investigators, and consequently numerous attempts have been made from time to time to improve that art, which has hitherto been considered almost perfect.

The chief advantages of Mr. Moore's process are, that he obtains, with a rapidity not hitherto known, a fine deposit of silver or gold, possessing a surface as smooth as glass, the character of the deposit being superior to that acquired by the ordinary slow deposit; and also that he can at any time ascertain the exact amount of silver or gold deposited on the goods by means of an apparatus, which obviates the necessity of removing the silver or gold plate or the articles from the bath, and subjecting them to the process of weighing. Consequently the goods can be left in the bath undisturbed from beginning to end of the electro-deposition, and need only be removed when the exact quantity of metal has been deposited thereon. In fact, when the desired quantity of silver or gold has been deposited, the apparatus is so constructed and arranged that the wires leading from the batteries to the bath become disconnected, and the action ceases, the goods receiving no further deposit.

It needs no comment to those acquainted with the process of depositing metals of every kind by electrical action to impress them with the vast importance of this new discovery, as they will eagerly and gladly appreciate and profit by its advantages, and the facilities it affords of at once overcoming the many difficulties that have always presented themselves to those who practice the art either by way of trade or otherwise.

Indian Population of Central British America.—Great misapprehension exists as to the numbers of the Indian population of Rupert's Land. They do not exceed 40,000 in all. The number inhabiting the prairies and plains of the lake Winnifreg and Saokatchewan districts do not exceed 20,000 at the present time. Under proper management the Indians would become most useful and tractable protectors of the proposed telegraph line described in our fourth number. Once impressed with the idea that it is something supernatural, they would cherish it, protect it, and reverence it as a "Maniton," or superior spirit, exercising a control over their fortune, and even lives.

REPORT OF THE DIRECTORS OF THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.

In presenting the periodical statement of accounts, the Board are again enabled to congratulate the shareholders on a steady improvement in the Company's revenue.

The causes which led the Directors to anticipate this result have continued in operation during the half-year. The receipts from American messages, *viâ* the South of Ireland, have much increased. The continental business has been considerably developed, and from the improved arrangements and extension of the system throughout Europe, and the East, a further expansion of this important field of traffic may reasonably be expected. An increased number of stations in Great Britain has also swelled the income, and the efficiency with which the service has been conducted, arising mainly from the superior condition of the Company's lines, has, the Directors believe, contributed largely to retain the confidence and support of the public.

The revenue of the Company from all sources for the half-year amounts to £137,150, exceeding that of the corresponding period of 1862 by the sum of £20,076.

On the ordinary working charges there is little to remark; but a perusal of the Electrician's report attached, will explain the cause of a large increase in the cost of maintenance. Extensive renewals have been effected, which have enabled the Company to perform their service with greater regularity and despatch.

The total expenditure for working charges and interest on debentures, amounts to £86,582, leaving a surplus of net profit on the six months of £50,568. Your Directors recommend a dividend of £3 10s. per cent. for the half year on the stock, and on the new shares (£5 paid), which will amount to £34,120, and leave a balance of £16,447.

This balance is larger than it has been usual to carry forward, but the Directors have no hesitation in recommending that it be placed to the credit of the trust fund for the reasons so frequently given, and so generally approved by the shareholders. The perishable nature of the best submarine cables, and the necessity of being provided with the means of replacing them, imperatively demands that this fund, which was exhausted in laying the new cable to Holland, should be replaced by accumulations from revenue.

The proprietors will remember that at their last meeting it was announced that the Directors had disposed of a portion of their leasehold property in Founders' Court for £16,000. In the June capital account the Company stands debited with the item "value of house property in London £10,161." Your Directors have therefore written off this amount, thereby reducing the capital to that extent, and have carried the balance (£5,839) to the trust account.

This fund on the 31st December, 1863, amounted, with interest, to £6,529; the two appropriations named above will increase it to £28,816.

After a service of fifteen years, your secretary, Mr. J. S. Fourdrinier, has retired, and in consideration of his long and faithful duty, and the zeal he has always exhibited in the interests of the Company, the Directors have unanimously resolved to recommend a pension of £300 per annum being voted to him. A resolution to that effect will consequently be submitted to the meeting.

Mr. Henry Weaver, one of the most experienced of the Company's officers, has been appointed to succeed him.

With deep regret the Board has to record the death of one of its oldest and most valued members, Mr. Thomas Critchley.

The following Directors retire by rotation at the present meeting: —Lord Alfred Paget, M.P., W. H. Smith, Esq., jun., Lieutenant-General Wylde, C.B., Mark Huish, Esq., and the Right Honourable Sir John Lawrence, K.C.B.; and being eligible, offer themselves for re-election, with the exception of Sir John Lawrence, whose appointment as Governor-General of India has deprived the Board of his active and valuable services.

The Directors have carefully considered the policy of filling the vacancies caused by the death of Mr. Critchley and the retirement of Sir John Lawrence, but; as the Board still numbers fifteen members, they have decided that it is not desirable to increase it, and they have, therefore, in pursuance of a clause in the Company's Act for that purpose provided, reduced the number to fifteen.

Robert Grimston, Chairman.

Electrician's Report.

January 20th, 1864.

Gentlemen,—Your circuits continue in excellent order. During the past autumn we experienced gales of great severity, and during the early part of December a hurricane traversed the country. Although the pressure of the wind reached the almost unprecedented force of 43 lbs. on the square foot, scarcely any of your poles were broken.

The timber between Newton, Carlisle, and Lockerbie on the west coast, and between Edinburgh and Berwick on the east coast, has undergone a thorough repair, it having been almost entirely renewed. These links between Scotland and the rest of your system are particularly exposed, and more interruptions have been experienced from gales over these sections than elsewhere. In carrying out these renewals the opportunity was accordingly taken so to remodel these lines as to secure them as much as possible against these periodical interruptions; the result has been that during the December gales not a single instance occurred of the wires becoming deranged over these sections.

The new wires erecting between London and Newcastle and London and Edinburgh have compelled us to replace nearly the whole of the timber between Peterboro' and Newcastle. The value of the precautions which experience has taught us to adopt when renewing a line was fully demonstrated in December last, when the new line stood admirably, not a single pole being broken.

The Dunwich Zaandvoort cable, two wires of which were defective at the date of my last report, was repaired on August 6th. As this cable has been broken several times within a distance of nine miles from Dunwich, the opportunity was embraced when repairing these wires to relay the greater portion of this section of the cable by means of the spare cable you had in store.

The slender single wire cable between North Wales and Dublin, has at last failed, and I do not think it can be profitably repaired, the iron covering being entirely consumed in many places by the action of the sea. We have therefore established direct communication between Liverpool and Dublin through your Wexford cable, which with the Isle of Wight cable continues in the same excellent order as when I last reported.

The two new wires between London and Liverpool are in full operation. The two between London and Manchester are partially so, the latter two, being completed with the exception of about one mile through the Stafford and Crewe Yards. These wires will be open before another week elapses.

The new wire to Edinburgh will be working early in February next, as also that from London to Newcastle.

The system of establishing direct communication between your important stations so as to save manual transmission, and the consequent clerical errors and delays, is steadily progressing. London now communicates direct with nearly every principal town of Great Britain, most of which possess the means of direct intercommunication.

The steady improvement in the insulation of your lines has considerably expedited the rate of transmission.

Since my last report the following works have been completed:—

The erection of the telegraph on the Inverness and Perth Junction Railway, on the Conway and Llanrwrst Railway, on the Brecon and Merthyr Railway, on the Milford Railway, on the Dumfries, Lochmaben, and Lockerbie Junction Railway, on the Romsey Railway, on the Skipton and Colne Branch of the Midland Railway, on the Falmouth Extension of the Cornwall Railway, on the Swansea Extension of the Vale of Neath Railway, and on the St. Ives and March section of the Great Eastern Railway. Two new circuits have also been opened between London and Liverpool.

The following new works are in progress:—

The erection of the telegraph on the Hereford, Hay, and Brecon Railway, on the Caermarthen and Cardigan Railway, on the Newtown and Machynlleth Railway, and on the Aberystwith and Welsh Coast Railway; besides these there are in hand numerous additions to the existing system of telegraph for the various railway companies.

	Dec., 1863.	June, 1863.	Increase.
Miles of Line	8,230	8,006	224
Miles of Wire	39,042	36,921	2,121
No. of Instruments	4,489	4,163	326

Cromwell F. Varley,
Electrician.

TELEGRAPH TO INDIA COMPANY (LIMITED).

The third ordinary general meeting of the shareholders of this company was held at the offices, No. 62, Moorgate-street, on Monday last, for the purpose of receiving and considering a report of the directors, for declaring a dividend, and transacting the ordinary business of the company; the chair being occupied by W. Dent, Esq.

The Secretary having read the notice convening the meeting, and the report having been agreed to be taken as read,

The Chairman said that he was glad to be able to congratulate the shareholders on the favourable state of their company, which was more than at one time was expected, after the failure of the attempt to repair the cable. Had that attempt been successful they would have received from 25 to 30

per cent. more on their capital than they had. The attempt having failed the cable had become worthless whilst submerged, and they had failed in obtaining any offer for it because the expense of taking ships round the Cape, to raise it, would be greater than its value when raised. If it could have been repaired its value to them would have been very great. He was glad to inform them that their assets had realised favourably, and he hoped that, when the Malta and Alexandria cable were in active work, the shareholders would receive a remuneration for the money they had invested, either by leasing it to another company, or working it themselves. (Hear.) The more the telegraphic system became known by the Egyptians, the more it would be used, and as a large portion of the traffic was local, and greatly on the increase, the working would be much more profitable, and there would be every probability of the shareholders getting out of the company without loss. When the Alexandrian line was at work their earnings were £250 per week, but he was sorry to say that the Malta and Alexandria line had again given way; the contractors and lessees (Messrs. Glass & Elliot) had, however, sent out a vessel to repair it, which they hoped to do in a very short time. By the interruption of the communication for about two months Messrs. Glass & Elliot were entitled to deduct from the company £200, but they had allowed that to stand over, reserving to themselves the right to claim it at any future time, as, according to the conditions of their lease, they were entitled to deduct a certain amount whilst the cable was not working, on account of the reduction of their receipts. He regretted that the chairman of the board was not present, he having gone to India; and, therefore, in his absence, he would move the adoption of the report, with the statement of accounts.

Admiral HALL having seconded the motion,

A SHAREHOLDER wished to know if there was any probability of getting up the cable, and what would be the use of it?

The CHAIRMAN, in reply, said that it would not pay the expense of raising it.

In reply to a question about the sale of the house at Aden, no mention of which appeared in the accounts, the Chairman said that it had been sold for £1,800, but had not yet been paid for, therefore no mention had been made of it.

A SHAREHOLDER said there appeared to be some little confusion as to the revenue and capital account, the assets of the capital account—£8,564 15s. 10d.—having been transferred from the revenue account; so that, practically, the dividend would be paid out of the capital account. This he did not object to, so that they got their money at some time or other. He wished to know whether, with the balance on the revenue account of £2,544, the directors would be able to pay 6d. in the pound.

Mr. BILLING said that, if the £2,544 were divided, it would certainly give them 6d. in the pound, but it was so small that it would not be worth doing it. He did not like the £200 due to Messrs. Glass & Elliot standing over. It appeared as a gift to the company, and yet it was not so, and hereafter it might embarrass them. As a shareholder, when he found that there was no probability of recovering the line he had given up all idea of receiving anything for his money, and had written it off as lost; but, after what the chairman had stated, he thought there might be some hope, and he should be glad to receive anything which the directors could give him. (Hear.) He believed that the directors were working for the company entirely without remuneration, but he hoped that eventually they would receive some pay for their services, and so soon as the company was in anything like a position he should be pleased to propose their payment.

The CHAIRMAN said that the Pasha of Egypt proposed to extend the land line to Aden, but it was not the intention of their directors to go any further than they had already. As to the balance of £2,544, he considered it would not be well to touch that, as some of it might be required for repairs, and to enable them to retain their rights, instead of surrendering them to other individuals. When payment was made for the house at Aden that would be carried to the capital account, and he proposed that the amount remaining beyond the dividend should be carried to the same account. Like Mr. Billing, when he found that the attempt to recover the cable had proved fruitless, he had written the amount off as a loss, but still he believed they would yet get their capital back, or, at any rate, get their 5 per cent. whilst the company lasted, which would not be a bad investment.

A SHAREHOLDER said that when the line was first proposed it was promised to pay a large dividend; he believed, however, that the capital would ultimately be realised, but the large gain had not been obtained at present.

F. C. GAUSSEN, Esq., remarked that Sir Charles Bright had informed him, that none of the cables put down at present were looked upon as being very secure, and that these interruptions might be more frequent than hitherto.

A SHAREHOLDER thought that the shares were influenced detrimentally from the fact that they were £2 shares, that £1 had been paid upon them, and that they were liable to a call for £1 more. The consequence of this was, that their shares were only worth 5s. per share; whereas, if they were made £1 shares, paid-up, they would be worth 15s., and thus add to their value in the market.

The CHAIRMAN, in reply, said that there would be no further call upon the shares unless there was a good prospect of using it, and if so the shareholders would be called together to sanction it. The directors would take the suggestion with regard to the shares into consideration, and take legal advice upon its practicability. With respect to the Syrian Telegraph Company, negotiations had been entered into with them to connect the Egyptian line with the Syrian, but there was no intention of proceeding any further with it. If Messrs. Glass & Elliot felt inclined, of course they were at perfect liberty to do so. He believed they had consulted the Pasha as to allowing them a concession to carry on the line, and they were ready to pay 7½ per cent. for it.

The report, including the proposal of a dividend of 5 per cent., was then put to the meeting, and carried.

Mr. SEBAG proposed "that P. P. Blyth, Esq., F. C. Gaussen, Esq., and J. F. Leith, Esq., be re-elected to fill the office of directors of the company." As directors these gentlemen gave their services for the benefit of the company, and they were very much indebted to them. Whenever the company might realise anything he should certainly propose that they be paid, but if they were now willing to retain their position, as before, he should feel pleasure in supporting them.

Mr. BILLING seconded the motion, remarking that, whenever the question should be brought forward for their remuneration he should be most happy to support it.

The motion having been put, was carried unanimously.

Mr. SEBAG proposed, and Mr. ROBINSON seconded, "that J. A. Franklin, Esq., and A. S. Wildy, Esq., be auditors for the ensuing year, on the same terms as the directors, namely, gratuitously."

Messrs. Billing and Taylor having offered to act as auditors in the event of those gentlemen declining, the motion was put to the meeting, and carried unanimously.

Thanks having been voted to the directors for the way in which they had conducted the affairs of the company, the proceedings terminated.

CORRESPONDENCE.

THE PNEUMATIC APPARATUS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—When I addressed you from here I naturally anticipated a reply from Mr. Andrews, contradicting my statement.

Mr. Andrews' instruments were manufactured by Mr. Sandys and Messrs. Reid Brothers, and the books of the Submarine Telegraph Company will sufficiently show at what dates his various experiments were resolved into systems; for when instruments are ordered in sufficient quantity to supply the working of all the long lines of a Company, it would necessarily lead to the conclusion that the experiments and models had been satisfactory to their projector.

If Mr. Andrews thought of the pump so long previously, he could not have been greatly impressed with its merits, or he would not have caused such immense expenditure for dozens of sets of apparatus of other descriptions. His systems, with their accompanying complete sets of instruments (say ten or twelve of each sort) had been already changed three times previously.

1st. A balanced magnetized bar, similar to a scale beam, and working on knife edges or slight springs, with a single coil under each end. The working current was zinc from one end and copper from the other end of the cable.

2nd. A magnetized horse-shoe armature working between two electro-magnets; the upper magnet being an ordinary one working by repulsion; the lower one a continuation of a permanent magnet (something after Hughes's style). The writing current was as above; but there was an instantaneous current *of an opposite description sent before.*

3rd. The instrument named in Mr. Andrews' last letter, viz., an ordinary Morse with a second electro-magnet in the printing circuit. This second electro-magnet set loose an escapement movement, which was brought close to its stop by the ordinary clockwork. The writing current was copper at both ends of the cable, and the reversal (*sent after the working current in this instance*) zinc.

When I joined the Company in 1860, six or eight of No. 1 were on the shelves in the workshop. Mr. London had just completed the mounting of No. 2 system on all lines. A few months afterwards No. 3 was mounted, and No. 2 went to keep company with No. 1. Again a few months and No. 3 had to join Nos. 2 and 1, being replaced by the pump.

And yet Mr. Banks says the suggestion and its entire working out was proposed before I returned from the Mediterranean. If I mistake not, he used to add my name when speaking of the pump-handle and relay.

Mr. Guy's memory must be very retentive in this particular instance, for so little did he understand about mechanics, that whenever I went to Aldersgate-street I was invariably addressed direct to the workmen on that account by Mr. Guy himself. Is it likely Mr. Andrews would have taken the matter, or even a portion of it, out of the hands of the regular mechanician, who had, according to his own assertion, already gone through the entire working out of the apparatus, to entrust it to one who had nothing whatever to do with that department?

Now, sir, so much stress being put on the fact of the pneumatic relay having been worked out before my return, I think this is a fair challenge. Let Mr. Guy produce a single account (I appeal to the Submarine Telegraph

Company's books in this instance also) relative to any portion of a pump-handle or relay, not only before my return, but for some months afterwards, I will bow my head and retire. If he cannot do so, he may just as well talk of Mr. Andrews having mooted a steam relay.

Mr. A. makes a most gratuitous remark when he says *he* engaged me. He had no more right to engage anyone than I have myself, and, in fact, he was absent at the time—abroad, I believe. My nomination took place in the usual way, *i.e.* through the Secretary and Board of Directors. I am labouring under the disadvantage of being forcibly absent from town, or I could have furnished you with fuller details and further corroboration.

Your No. 4 only reached me on Friday, or I would have answered sooner.—Yours very obediently,

J. R. France,

Off Yarmouth, 1 Feb., 1864. Acting Engineer, Sub. Tel. Co.

To the Editor of the Telegraphic Journal.

Sir,—Will you allow me to say a word about the pneumatic relay? This relay I always supposed was unquestionably the invention of Mr. France, and if anything had been wanting to confirm the supposition in my mind, I should have found it in the following simple circumstance. Shortly after Mr. Andrews ceased to be engineer to the Submarine Telegraph Company I was appointed superintendent of the Cromer station, whence the longest cables leave the English coast, and it fell to my lot to have to remove from some of the most important lines, and replace with the pneumatic relay instruments which Mr. Andrews had invented, or which, at least, I know him to have had constructed *subsequent* to the invention of the pneumatic instrument. I was surprised at the time to find instruments so much more cumbrous and inefficient still upon the lines, and attributed it to a very natural partiality on the part of the late engineer for his own offspring over that of Mr. France. It is not possible to suppose that this invention would have been thrown aside by its inventor to give place to another far inferior in every respect, unless there had been some reason for his so doing.

I remain, Sir, your obedient servant,

T. Harwood,

Cromer, 30 Jan., 1864. Superintendent of the Cromer Station.

MR. SIEMENS' BATHOMETER.

To the Editor of the Telegraphic Journal.

Sir,—I have read some time since, with great interest, an account of Mr. Siemens' "Bathometer." Though I am not of opinion, giving results as it does, differing only 10 per cent. from the truth, that it can ever be regarded as a proper substitute for deep-sea sounding lines, with which we seek not less the ascertainment of the *character* of the bottom than the actual depth, yet I do think that its utility would be very great, if applied on board such steamships as are obliged to make quick passages under hazardous circumstances, (witness the late accident at Cape Race,) for there the transition from deep water to dangerously shallow, might probably be at once recorded by the instrument, without any diminution of speed. Founded, as that instrument is, on correct mathematical principles, it may, undoubtedly, be brought to greater perfection than it has yet attained, and this will, I am sure, be quickly done if the attention of its talented inventor be again given to the subject. J. H. Selwyn, Capt. R.N.

THE BONELLI TELEGRAPH.

To the Editor of the Telegraphic Journal.

Sir,—In answer to your correspondent, I beg to assure him that the accidental loss of a wire, or even two wires, does not at all affect us in the disastrous manner he supposes. Should he desire occular demonstration of this I shall be happy to afford to him, if he cares to come and see, how comparatively independent Bonelli's system is of "loss," "contact," and all the thousand ills "terrestrial" and "atmospheric" telegraphy is heir to.

I am, Sir, your obedient servant, Henry Cook.

Angel-court, Throgmorton-street, Feb. 3rd, 1864.

P.S.—With regard to the expense, &c., of constructing and maintaining a line of five wires, I beg to say that the Bonelli system is only intended to be introduced on circuits which are fully able to support the outlay, and that the extra cost (if any) will be fully compensated for by the great saving effected in all other departments.—H.C.

To the Editor of the Telegraphic Journal.

Sir,—Your correspondent, "D. P. L.," is in error when he states that the old double-needle instrument possesses advantages over the Morse in rapidity of transmission. In a fair trial made a few years ago, when their respective powers were severely tested, Mr. Culley, in his work, gives the following as the result:—"The highest speed on a circuit of a little under 200 miles was:—Double-needle, 35 words per minute; Printing (Morse), 38 words per minute. Average, if between two and three hours' continuous work, reporting a speech of Mr. Bright:—Double-needle, 24.3 words per minute; Printing (Morse), 26.5 per minute. And for a circuit of more than 400 miles:—Printing, average speed, 24.5 words per minute; clerk reading from the manuscript of the *Times* reporter, not always very legible." L. M. O.

THE PAYING-OUT OF SUBMARINE CABLES.

To the Editor of the Telegraphic Journal.

Sir,—I beg through your valuable journal to be allowed to warn Mr. Siemens against the inevitable consequences of making a great fly-wheel by putting the cable on a drum *in* a ship. Not only does this scheme utterly fail to meet the dangers inseparable from the motion of a ship on the sea, but it is a true fly-wheel, which a cylinder supported *in* water is *not*. The diameter, when full and empty (of cable), is subject to much greater variation, and the benefits gained by the use of a large and long cylinder in this direction are totally lost. Let no one, therefore, say, that if this attempt fails any conclusion can be fairly drawn that the floating cylinder will also be found useless. J. H. Selwyn, Capt. R.N.

RAILWAY TRAIN SIGNALLING.

To the Editor of the Telegraphic Journal.

Sir,—The subject of railway train signalling is undoubtedly one of very great importance, and well deserves a fair discussion in your columns. We have several systems in operation on the various railways, but most of them are exceedingly complicated, and cannot be much relied upon; and, I believe that the plan originally suggested by Mr. Fothergill Cooke still maintains its ground as the most certain and simple in its action and character. As almost all our great lines of railway can now be traversed in all directions by trains without the necessity of changing engines, carriages, or officers, it is exceedingly desirable that there should be uniformity in the mode of electric signalling, as there is in that of signalling by the semaphore, and that the adoption of electric signalling should be made compulsory by an Act of Parliament for the better security of the lives of the travelling millions. Another important application of electricity would be to effect communication between the guards and the engine-drivers. The many serious and fatal accidents which have occurred in consequence of the absence of such a plan of communication points out the necessity of its adoption being rendered compulsory on the part of the companies.—Yours obediently,

2nd Feb., 1864. J. L. Martin.

THE LAST TELEGRAPHIC FEAT.

To the Editor of the Telegraphic Journal.

Sir,—The notice of "the last telegraphic feat" in your Journal of the 30th January has afforded considerable amusement to the clerks of the Magnetic Telegraph Company here—myself among the rest,—the rate at which Messrs. Scholefield and Bright's speeches were transmitted being considered a very poor performance indeed, even for the Morse. 12,000 words on three wires in five and a half hours, is equal to about 13 words per minute on each. Now, on the instruments chiefly used by the Magnetic Telegraph Company—namely, Sir Charles Bright's bell—30 words per minute is considered a very moderate rate for the transmission of messages, and to manage a column of news in an hour on one wire, the clerk receiving and writing for himself, is of frequent occurrence. I think, sir, that the merits of this instrument are not at all known or estimated at a proper value, or such *feats* would not be recorded. Any one acquainted with both systems must admit that the bell is by far the quickest single-wire instrument. I am aware that Cooke and Wheatstone's double-needle instrument is reputed to be the quickest at present in use; but the fact of two wires being required as well as a writer, is a great objection to it. So long as telegrams are written by the hand, I consider it impossible, for any practical purpose, to get a superior instrument, as it can be wrought at a speed that would perplex the quickest writer to keep up to. Hoping you will give this a place in your Journal, I am,

Glasgow, 2nd Feb., 1864. A Bell Clerk.

A SUGGESTION.

To the Editor of the Telegraphic Journal.

Sir,—I have only recently had an opportunity of seeing your journal, and I must certainly congratulate you upon having produced a thoroughly representative organ. I am no stranger to the management of a newspaper, and, of course, know some of the difficulties experienced in the *sanctum sanctorum*; and I am persuaded that, if they were more generally known, editors would often receive valuable co-operation from their readers, especially in class literature. It occurred to me that you must either employ a large staff, or else be obliged to labour most assiduously over newspaper files, culling the scraps which you publish from time to time under the head of "Telegraphic News." Now, I have a suggestion to make whereby you will be saved a vast amount of trouble, without inconveniencing others. You have supporters in all parts of the country, each in the habit of perusing his local journal. Every paper, at times, has notices of interest to telegraphists, and if you could but induce some of your numerous subscribers to cut and post you the said *morceaux*, you would never be without a good column of news. It is hardly to be expected that even an editor can know everything that transpires in the United Kingdom and abroad, unless he has a staff of "special correspondents;" and, therefore, I am sure you would esteem any service thus rendered by your readers.—I am, Sir, yours,

Yorkshire, 2nd Feb., 1864. H. Elp.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Has not the earth wire, bound round the cross arms, instead of direct to the insulators, been in use for some years by the old telegraph companies? I am, Sir,

London, 1st February, 1864. A LADY TELEGRAPHIST.

[Perhaps some of the gentlemen employed under the old companies will reply to our fair correspondent's note.—Ed. *T. J.*]

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Can any of your readers inform me, through the medium of your valuable Journal, what the component parts of the solution are with which to prepare the paper for printing instruments, that it may be used *dry* instead of damp, and oblige,

Your obedient servant,

Holyhead. SEMPER.

TELEGRAPHIC NEWS.

THE PROVIDENT CLERKS' FUND.—Mr. Cyrus W. Field has generously contributed the sum of £5 towards this excellent fund, and favoured the secretary with introductions to some of the leading friends of telegraphy in America.

WE are rejoiced to learn that Mr. E. B. Bright, the manager of the British and Irish Magnetic Company, is recovering from a very dangerous illness. The greatest interest was felt at Liverpool whilst his state was precarious, as he is greatly respected in that city for his talents and high character. During his illness he has been most ably attended by Dr. Fitzhenry, of Waterloo; Dr. Cameron, of Liverpool; and Dr. Stephen Ward, of London.

THE UNITED KINGDOM TELEGRAPH COMPANY have now extended their wires to Newcastle, and, in the course of a short time, they intend formally to open business in the town. The company have now communication with nearly all the large centres of population in England.

UNIVERSAL PRIVATE TELEGRAPH COMPANY.—The aerial cable belonging to the above company, and which runs parallel with and above the houses on the south side of Cannon-street, E.C., was severed by the fire which took place in Turnwheel-lane on the 3rd instant. It appears to us that the company's arrangement in suspending their cable directly above the buildings renders the operations of their lines exceedingly precarious and uncertain.

LONG AND SHORT CIRCUIT.—Messages between Hamburgh and Copenhagen are now transmitted through London, twice crossing the German Ocean.

THE QUEEN'S SPEECH.—The great event of the year in telegraphy, the transmission of Her Most Gracious Majesty's speech, took place on the 4th instant. The speech, immediately on its delivery, was transmitted by the Electric and International Telegraph Company from its chief station in Telegraph-street to Vienna, Frankfort, Berlin, Rotterdam, &c. A portion of the speech, consisting of some 300 words, was sent to Hamburgh in 29 minutes. We had the opportunity of witnessing the transmission of the message to all the principal towns in the United Kingdom, and which we found to be at the rate of 35 words per minute. We are indebted to the obliging assistant-secretary of the Submarine Telegraph Company, Mr. Wichello, for the following information:—"The Queen's speech consisted of 900 words odd. Its transmission to Paris commenced at 1.22 p.m., and was finished at 1.36 p.m. Six wires were employed." Our readers will judge of the expedition with which the speech was transmitted from the following facts. Mr. Wichello was at the Treasury 2 minutes past 1 p.m., reached the chief office of the company at 1.22 p.m., and the speech was published in Paris in 14 minutes. The speech was also transmitted from London to Liverpool by the British and Irish Magnetic Telegraph Company on two of "Bright's" Bell Instruments in nine minutes. The speech contained 867 words, which gives an average of 48 words and a fraction of a word per minute, and when it is taken into consideration that the receiver writes for himself, the speed of transmission is truly marvellous. We are indebted to Mr. Walsh, the engineering superintendent, for the above interesting particulars.

THE TELEGRAPH AND THE BIRMINGHAM MEETING.—The lengthy report of the meeting at Birmingham on Tuesday evening, which appeared in the *Courier* of January 27, was transmitted from Birmingham to Manchester by the United Kingdom Electric Telegraph Company; and it is only right that the accuracy and despatch with which the task was accomplished should receive due acknowledgment. For the first time, probably, in the history of telegraphy, the operators at the instrument forwarded the report from dictation, the usual plan being to have a written or printed copy before them. On the present occasion, however, the whole of Mr. Bright's speech, which was given verbatim, was read to the operator from the short-hand writers' notes, and thus a saving of labour to the reporters and of time in the transmission of the report was effected. The entire report, extending over nearly five columns, was in Manchester by about half-past twelve o'clock, the meeting itself not having terminated until after ten.—*Manchester Courier*.

THE PERSIAN GULF CABLE.—News has been received this week from Colonel Stewart, Sir Charles Bright, and staff, who were still at Bombay, awaiting the arrival of the second vessel, the *Kirkman*, which was daily expected. All reported as well.

BONELLI'S TYPO-ELECTRIC TELEGRAPH.—A few of the leading members of the press, and of the scientific world, met last Wednesday at the offices of the company for the purpose of witnessing a series of special experiments on the working of the system. In addition to those which were so conclusive at the former meeting, some very interesting proofs were shown of the independence of loss to earth, and of metallic and intermittent contact, certainly to the surprise of those best versed in the science. A loss deflecting a galvanometer 75 degrees, and sufficient to make a dark band upon the paper, was completely neutralised by the beautiful system of currents invented by the talented Chevalier, and much interesting discussion took place as to the setting up of the type, the phenomena involved in the decomposition of the manganese, &c. The proof adduced and the explanations given were in each case most satisfactory. We most highly approve the open and candid spirit which dictates these meetings, and feel that they must tend to disabuse the minds of those who have been from various causes inclined to undervalue this beautiful and truly scientific invention. Among those who were present, and whose evident delight afforded the highest testimony to the merits of the system, we noticed Mr. Fleeming Jenkin, Mr. Charles Lamb Kenney, Mr. Dodd. Mr. Murphy, Mr. Williams, Lord Otho Fitzgerald, Mr. Le Neve Foster, Mr. Latimer Clarke, Mr. Woods, Mr. Turner, Mr. Fitzgerald, and Mr. Bateman.

THE PROPOSED NEW RAILWAYS AND TELEGRAPH PROPERTY.—The number of *notices* served upon the metropolitan telegraph companies by the solicitors of the new railway projects have been very numerous. We are informed that one company alone has been served with no less than forty of such *notices*, in which it is stated that, it being understood "you (the telegraph company) are interested in the property (telegraph wires) mentioned in the annexed schedule in the way in which the schedule states, that property, or some part of it, will, or may be required, for the purposes of the said Act, and it will either be traversed by the line of the proposed works in the manner mentioned in the schedule, or it may be required to be taken under the powers which will be applied for in the said Act of deviating from the line now laid down to the extent shown on the plans of the undertaking, &c." There is one project, if we are correctly informed, called the North and South London (*high level*) Junction Railway, which is likely in some parts of the town to vie in altitude with our aerial cables and wires.

PRIVATE TELEGRAPHY.—Most of our readers are aware that in London, as well as in many of the provincial towns of England, a system of connecting by telegraph merchants' offices with warehouses, mills, or other business premises, has been very generally adopted, and, we understand, has proved entirely satisfactory to the parties interested. Some short time ago, in scanning over our "exchanges," we noticed, in an article on "Private Telegraphs" in the *Telegraphic Journal*, that one merchant had been enabled, by its means, to dispense with the services of no less than four messengers, thus effecting a considerable saving in his annual outlay, without estimating the advantages derived from rapid communication. From a circular issued by the Magnetic Telegraph Company it appears that, for the sum of about £50, any one can become the proprietor of a complete telegraph, one mile in length, including two admirable instruments (one for each end), which the telegraph company will keep in working order for the further sum of £6 per annum. This, with say 5 per cent. on the purchase-money, will amount to £8 10s. per annum; so that, for a sum equal to the annual payment of £8 10s., a merchant can have complete telegraphic communication between business premises a mile distant. Longer distances do not add much to the expense, as the same number of instruments only is required. It appears to us (and the suggestion may be worth the consideration of the telegraph company) that a considerable saving of time might be effected by connecting merchants' offices with the central telegraphic station. The town council might certainly make use of this system of communication in connection with the fire brigade. Through the exertions of Sir John Gray and Captain Ingram, the chief of the fire brigade, Dublin, the town council of the Irish metropolis have had several stations connected by the Magnetic Telegraph Company for the use of the fire brigade. Property of considerable value has already been saved by the timely arrival of the engines, which would inevitably have been destroyed but for the rapidity with which information has been flashed from station to station. So fully convinced are the Dublin council of the necessity for prompt and immediate attention in such cases, that they have decided to have all their fire-engine stations fitted up with the necessary telegraph appliances. We are not aware whether the council defrays all the expense, but we should think that the insurance societies would be glad to co-operate in a matter which is so important to their interests.—*Belfast News-Letter*.

TELEGRAPH WIRES.—Although England for some time has monopolised the supply of telegraph wire, it appears now that Belgium is likely to prove a formidable rival in the future supply of the material. The State adjudication for wire for telegraph purposes was divided among various contractors; and we learn that one of the firms selected, having made within a period prescribed an abatement of 10 per cent., has obtained the delivery of the whole of the wire required. The fabrication is now in progress at one of the works of the Moselle district.

Telegraphic communication in India promises to be greatly improved. Mr. G. W. Kellner has lately been instituting an inquiry into the conduct of the electric telegraph department, which will lead to many important reforms in that much mismanaged branch of the public service. A system of false economy, extending even to the employment of common servants in the head office here, has completely destroyed the efficiency of the department. A new company also, called the Oriental Telegraph Company, has been organising, under the superintendence of Sir Charles Bright and Mr. Latimer Clark, a system of telegraph similar in its constitution to the Electric and International Company of England. Proceedings are now so far advanced, that the company is only waiting for a reply to a reference made to Sir Charles Wood. On the completion of the Persian Gulf submarine cable early next year, Sir Charles Bright and Mr. Latimer Clark will be ready to enter upon the operations of the Oriental Telegraph Company, commencing their Indian line from Kurrachee, and working towards Bombay and Calcutta.—Calcutta correspondent of the *Manchester Guardian.*

The Telegraph in Turkey.—The correspondent of the *Times* writing from Constantinople states that "the English Government have just sent out an agent to come to an understanding with the Turkish telegraph department as to the future working of the wires through Asiatic Turkey, which are soon to form one of the links in the Indian telegraph. It has been ascertained that, although the line to Bagdad has been successful, the posts are all rotting away, and will have to be changed. One of the principal difficulties is to be found in the impediments put in the way of the construction of the line from Bagdad to Bussorah by the Arabs. A party of English telegraphists was lately attacked near Bagdad, and all the telegraph material was carried away into the desert. On this section of the line it has been decided to use iron posts. These are a strong temptation to the Arabs, who use them as tent poles. The only way of obviating the difficulty is by coming to an arrangement with the Sheikhs of the different tribes, and granting a subsidy for protecting the line. Without that it is to be feared that there will be constant interruptions, especially as the Governor-General of Bagdad has no control whatever over these tribes. This arrangement has worked well at Mosul, where the line was exposed to the playful tricks of these marauding bands. At the outset the Government subsidized the chiefs, and now, far from injuring it, they contribute to keep it in good order. It is said that when the entire line is open for traffic to India, the Turkish line alone will yield upwards of £100,000 a-year, and with such prospects it is to be hoped that the Turks will give up such a portion of management to the English employés as may secure the proper working of the line—a success which their own department, as at present constituted, would find it difficult to achieve."

MISCELLANEA.

Mr. Culley in his new work gives the following list of insulators and conductors, the first on the list being the best insulator, and the last the best conductor:—

Ebonite.	Pure water.
Shellac.	Melting ice.
India-rubber.	Sea water.
Gutta-percha.	Saline solutions.
Resin.	Acids.
Sulphur.	Charcoal or coke.
Wax.	Mercury.
Glass.	Platinum.
Silk.	Lead.
Wool.	Iron.
Dry paper.	Tin.
Dry air.	Zinc.
Porcelain.	Gold.
Dry wood.	Silver.
Dry ice.	Copper (pure).
Stone.	

The Philosopher's Reward.—Whatever may be the difficulties of the task before us—and difficulties great and many there are—we may rest assured in the reflection that our reward is certain. No man ever followed the study of nature with honesty and diligence without an ample repayment of discovery. The particular object sought may not at that moment be attained. None can tell at the outset of an investigation where it may lead, or in what way it may terminate; but this is certain, that lead where it may, and terminate where it may, new, important, and interesting truths will have been met with, and the boundaries of human knowledge permanently enlarged. Disappointment in the study of nature is impossible, provided legitimate objects be alone pursued, and by the appointed means. When physical truth ceases to be admired and loved for its own beauty and excellence, and scientific discovery becomes merely valued as a source of personal reputation—as the road to wealth and power and earthly dignity, then, indeed, may the bitterness of disappointment be often felt, and jealousy and bickerings divide those who, beyond all men living, should be the first to set an example of unity and brotherhood, whose lives are habitually passed in the contemplation of the handwriting of God.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.	
Genuine mixed, first and second qualities.	2/3 to 2/6 per lb.
Good re-boiled	1/7 to 1/10 „
India Rubber.	
Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/6 „

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph	100	107 to 110	—
100	Submarine Telegraph, scrip.	all	45 to 55	—
all	Do. registered	all	$\frac{1}{4}$ to $\frac{1}{2}$	—
5	United Kingdom Telegraph	3	$\frac{1}{2}$*d* to par	—
10	Mediterranean Extension Tel.	all	4 to 5	—
5	London District Telegraph Co..	all	$1\frac{1}{4}$ to $1\frac{3}{4}$	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal,* 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street West; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms (paid in advance):—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)	0	3	0

Single Advertisements from the country must be accompanied with stamps in payment.

THE TELEGRAPHIC JOURNAL.

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THE ORAN AND CARTHAGENA DEEP SEA CABLE.

The accident to the above cable, as announced in our last number, has cast a gloom over the spirit of enterprise so far as it is directed to the development of deep sea telegraphy, and which is to some extent aggravated by the fact that the great commercial interests of the country are smarting under the inconvenience and loss experienced by the protracted silence of the Malta and Alexandria cable.

The French telegraph screw steamer, *Le Dix Decembre*, left the Thames, on the 16th December, with 130 knots of cable on board, destined to connect the Spanish town, Carthagena, with Oran, in the north-west of France. With the exception of a few days' delay, in consequence of unpropitious weather, the vessel arrived safely at its destination, and on the 28th of January the operation of laying the cable was commenced; and it appears, from the report of Mr. Siemens, that the operation progressed to his entire satisfaction and the other engineers on board for about one third of the way, when the cable suddenly broke in a place where the hempen strands appeared to have been unduly weakened by some chemical agency; the depth, at the time, being about 2,700 metres. We have already, in a previous number, referred to this cable as being of novel construction; its outer covering, which formed its strength, consists of a double layer of hemp strings, or lines (of the strongest materials, saturated, we believe, with Stockholm tar), laid spirally under considerable tension, the twist of the two layers running in opposite directions, and it was finally covered by a flexible copper or brass sheathing composed of bands of sheet copper or brass, put on spirally under the influence of great pressure, and with each succeeding turn overlapping the preceding, resembling, to some extent, the scales of a fish. The conductor was enveloped, as usual, in several coatings of gutta-percha and Chatterton's compound. The novelty of construction, and of the means adopted for paying-out the cable had, for some time, given rise to much speculative discussion among telegraph engineers, and others interested in the progress of deep-sea telegraphy, as to the amount of success which might be expected in an attempt to submerge a cable in great depths, under conditions of avowed novelty and by no means devoid of ingenuity. If the cause of failure is correctly ascertained to have resulted from some chemical agency impairing the strength of the hempen cords, while in the course of transit, the adaptability of the cable for the purpose it was intended, or of the machinery employed on the occasion, cannot justly be doubted, as some 40 knots of the cable were successfully submerged in great depths; and so convinced were the French and Spanish engineers on board of the superior merits of the cable, and of the machinery, that they recommended the same for future adoption. It is not our wish, or inclination, to aggravate or embitter, by any observations of our own, the pain or the disappointment already experienced by those more immediately concerned, but rather to unite, with an enlightened and considerate community, in an expression of sympathy for those whose reverses are after all, we trust, but steps which ultimately will lead to success and triumph.

We would here impress upon the minds of our readers the fact, that the practicability of deep sea telegraphy is not in the least affected by the late accident. We believe, as firmly as ever, "that a well-insulated cable properly protected, of suitable specific gravity, made with care, and tested under water throughout its progress with the best known apparatus, and paid into the ocean with the most improved machinery, possesses every prospect of not only being successful in the first instance, but may reasonably be relied on to continue in an efficient state for the transmission of signals."

In order, however, to remove the doubts which possess the public mind, we trust that the portion of the Oran and Carthagena cable, in which the deterioration had taken place in the tensile strength of the hemp, will be subjected to the severest tests, so as to ascertain the true cause thereof, and, if possible, to arrange some means of determining the uniformity of strength before the cable is coiled for submersion, as it is strongly suspected that other cables have had their "weak points," only to be discovered, when too late, in the operation of paying out into the ocean.

As we were on the point of concluding our observations intelligence reached us that the cause of failure was at a splice made at the contractors' factory during the shipment, and that the hemp at that particular place was, on investigation, found discoloured and damaged by some chemical agency, as acid, which, by some unlucky accident, must have had access to the place while the joint was being made. In all other parts of the cable the hemp is represented as being in as good and unchanged condition as ever.

HOW TO POPULARISE TELEGRAPHY.

Nothing would appear to be more foreign to a journal of this nature than to assume the right of dictating to the large telegraph companies the course they should pursue to bring before the public notice the value of "what they have to sell." As, however, the welfare of telegraphy, and the success of our vast telegraphic system will admit of a practical suggestion, Why, we should like to ask,—why is it that we know so little of the changes that take place in telegraphic arrangements? We allude more especially to the reduction in tariffs, and other advantages so frequently placed at the public disposal, if they only knew of them. While railway companies and insurance companies lose no opportunity of bringing forward, with every means of publicity in their power, the benefits of their excursion trains on the one hand, and of life assurance generally on the other, the telegraph companies prefer to hide their most wonderful and valuable commodities from all public gaze. They apparently make no effort to send forth information, but expect the world at large to ascertain these full particulars which may, no doubt, "be obtained at any of the company's principal stations."

It is not alone in the metropolis, but in all the provincial towns, that the custom of the telegraph companies is confined to a very select circle. Ninety-nine people out of a hundred will scarcely be aware that they can telegraph at all; certainly not that, for the sum of one shilling, they can waft their wishes 200 miles in less than a minute. The system of private telegraphs is one step towards bringing the public system more generally into use, and a reduction in the public tariff has been naturally followed by a large increase in the number of tele-

grams, still there must be a large class who are not included amongst the telegraphers.

It is not our wish to see any part of the companies' revenue wasted in superfluous advertising, but it must surely be apparent to the directors of all telegraph undertakings that publicity is calculated to bring an exceedingly large increase to their present income. It would be interesting to know what per centage of the population is found to use the telegraph systems.

As an instance of the fallacy that, no doubt, is widely spread, a medical man, of high repute, sent off his man-servant with a short message to Paris, and gave him *two sovereigns* to pay for it, desiring, if that was not enough, that they would let the message go forward, and his servant should return immediately with any balance due. He was perfectly astonished to find that the cash brought back was thirty-five shillings; that, in fact, his message had only cost him *five shillings*, while for the amount he had supplied his message might have been sent to St. Petersburg, and an answer received. Now this, we feel sure, is not as it should be. The electric telegraph is for an emergency in private life, as well as for a regular service to the merchant, or broker, and it is curtailing its boundless sphere of usefulness to allow it to be viewed as a means only to be used for and by the wealthy classes. Who is likely to make his first attempt at a telegram, if he thinks the cost will be half-a-week's income? "I didn't know that I could telegraph," says the working man; "had I known that it would only cost ninepence, I would have telegraphed at once for my wife to see her dying child." He knows he can have eight hours by the sea-side for half-a-crown, but continues to believe that that wondrous electricity is kept in bottles, like old wine, the taste of which is denied to him.

Day by day, as we take up our morning paper, everything is brought before us in full blast of letter-press, *except* the telegraph service.

Granted that placards are erected at the telegraph offices; granted that all these blessings may be had; and granted too that the public are served well and cheaply: but then the people are ignorant of this, and while that continues the service must be more or less exclusive. We wish to remark, however, that one step has recently been taken by the London District Telegraph Company, in distributing widely an almanack and list of stations, in pocket-book form. This is a right step. It would be difficult to send abroad too many; they will simply represent good seed sown on ground that is calculated to reward the sower with a plentiful harvest. The large sheet almanack distributed by the Electric Company is also a good and useful counting-house reference, and it is usual to give away large quantities of tariff sheets; these, however, mostly find their way to those accustomed to telegraph regularly. It is, we think, worthy of consideration whether it would not be to the advantage of the different companies to keep their distinguishing merits well before the public, in those daily and weekly journals that, in their advertising columns, always contain so much valuable information, and which are read with interest by the intelligent portion of the community.

Progress of Canada.—Any one who cares to examine the progress of Canada during the last 25 years will be satisfied, we venture to say, that the future of that country is secure beyond all precedent. In 1825 Canada had 581,920 inhabitants; in 1851 these numbers had trebled, or reached 1,842,265; and in 1861 they had quadrupled, being 2,506,755. At this time the population of Canada approaches three millions. On the roads, railroads, and canals of the province sixty million of dollars have been expended by the Government, apart from the advances made by the English capitalists. There are now 1,800 miles of railway and 3,422 miles of electric telegraph completed. The number of letters passing through nearly 2,000 post-offices were upwards of 9,000,000 in 1860. These facts show that the civilisation of the country is progressive and in strict accordance with the spirit of the times.

SUBMARINE CABLES.

II.

In our last number we quoted at some length the opinions of telegraph engineers and others upon the subject of corrosion, which has so materially affected the permanency of submarine cables—more especially when submerged in shallow water, as is the case with most of our present cables. Although this cause of danger had been foreseen in time to provide against its recurrence in the expensive line between Malta and Alexandria, still no precautionary measures were adopted, and it is to be feared that in this instance, as observed by Mr. C. W. Siemens, F.R.S., that "so far from the iron being an element of strength," it will become "an element of actual weakness when the cable requires to be raised for repairs." Indeed, we find that Sir Charles Bright, at the discussion upon Mr. Preece's paper on Submarine Cables, recommended that means should be adopted to protect the said cable from corrosion. It will be interesting to some of our readers who have not had the opportunity of reading the ponderous "Blue Book," containing the result of the investigations of the late Submarine Telegraph Committee, to learn of the attempts made by some of our ingenious inventors and enterprising manufacturers to contrive cables with a view of avoiding the above serious effect of corrosion, &c.

Mr. Thomas Allan proposes a cable of a novel and ingenious construction, dispensing altogether with an external iron coating. The cable consists of a copper conducting wire of a large size, covered spirally with a number of steel wires of gauge 25, and coated with an insulating material of the required thickness, the whole finished in a covering of plaited jute, &c. One of these cables was weighted to 1,787 lbs., and the extension before removing the weights did not exceed ·67 per cent. The permanent extension upon a length of 20 feet was = ·234 per cent., the return = ·443 per cent., and the breaking strain equal to 4,698 fathoms. Other specimens had breaking strains of 6,348 and 7,484 fathoms respectively. Mr. Allan produces a cable which certainly possesses several important advantages besides that of having its element of strength completely protected from the corrosive influence of water; it is small in bulk, of light specific gravity, great strength, and not liable to kink.

Mr. Godefroy has contrived a cable in which the conducting copper wire is insulated in either gutta-percha or india-rubber, outside of which, for strength, a number of steel wires are placed in close parallel lines, the whole being afterwards insulated or enveloped with patent cocoa-nut gutta-percha, and again with two coatings of india-rubber waterproof canvas. One of such cables was weighted to 1,787 lbs.; the extension before removing the weight was = ·520 per cent., the permanent extension = ·182 per cent., and the return = ·338 per cent. This description of cable, like that of Mr. Allan's, is exclusively intended for deep-sea lines.

Messrs. Hall & Well's cable consists of a copper conducting wire covered with india-rubber, closely served with tarred thin yarns, a number of longitudinal hemp lines and longitudinal steel wires braided together, with strands of hemp saturated with best Stockholm tar. One of these cables was weighted to 1,787 lbs.; the extension before removing the weight was = ·416 per cent., the permanent extension after removing the weight = ·208 per cent., and the return = ·208 per cent. This kind of cable is free from liability to kink, has a light specific gravity, combined with great strength. The breaking strain is from 5,000 to 11,000 fathoms.

Mr. Sinnock describes his cable as follows:—Core of strands of copper wire covered with gutta-percha served with waterproof tape, then eleven longitudinal thick marlin lines, each consisting of nine tarred yarns served spirally with hempen string, the whole served with two turned iron wires and three tarred strings. One of his cables was weighted to 1,787 lbs.; the extension before removing the weight was = 1·664 per cent., the permanent extension was = ·933 per cent., and the return = ·728 per cent. Breaking strain equivalent to 2,855 fathoms. This is a compact and exceedingly well manufactured cable.

Messrs. Silver & Co. produce a cable consisting of a copper conductor insulated with india-rubber, then served with tarred yarn, outside of which steel wires in close parallel lines, and covered with plaited hemp saturated with a peculiar compound. The breaking strain equivalent to 2,675 fathoms. Messrs. Silver & Co. exhibited several specimens at the International Exhibition, differing in some respect from the above, and which appear to us to be well adapted for the purpose of ocean telegraphy.

Mr. De Bergue's are, perhaps, the most perfect hempen-covered cables hitherto contrived. Very small in bulk, light specific gravity, and great strength. A cable having an external diameter of $\frac{8}{16}$ths of an inch, breaking strain exceeded 16,000 fathoms. The following is a description of the cable:—A core of seven strands of copper wire covered with gutta-percha, next seventeen longitudinal tarred hempen lines served with similar sized cord of hemp.

THE PROTECTION OF SHIPS' BOTTOMS BY ELECTRICITY.

IT may be truly said that maritime supremacy, and the successful development of mercantile enterprise, hinge upon the attainment of the maximum of speed. Yet, notwithstanding the thousand and one paints, varnishes, and compositions, which have been consecutively introduced of late years to compass this desirable object, it still remains a desideratum. The clean hulls of vessels as they emerge from port, are still rapidly encrusted with barnacles, shell-fish, and sea-weed, to the great detriment of their sailing or steaming properties, and the creation of a vast additional expense in the increased length of time occupied in the voyage. To show the magnitude of the evil here referred to, it not unfrequently occurs, that a steam ship, leaving port with an initial speed of eleven and a-half knots an hour, has that speed reduced, in three or four weeks, to eight knots an hour, by the adhesion of barnacles, whose presence and neutralizing force might be extinguished, by the employment of proper means. It was formerly thought that this object might be accomplished by poison, and hence a variety of toxicological compounds were from time to time incorporated with the *protective* composition; but these have been found of no avail, for barnacles and adherent shell-fish possess the power of producing and using with instinctive judgment a most powerful cement, capable of speedy induration; and no sooner do they begin to feel the evil effects of the poison in question, than they quickly interpose an impenetrable shield of hard calcareous matter between themselves and the poisoned surface of the ship's hull.

The only power that can be effectually employed in their destruction and detachment, must be at once prompt, searching, diffusive and inevitable. Such a power is electricity. Its influence is great over all organised structures, particularly over the nervous and muscular systems of animals; and of all the divisions of the animal kingdom, fishes are the most keenly susceptible of its overpowering influence. This arises, no doubt, in great part from the fact, that the entire surface of their bodies is generally in perfect electric contact with a good fluid conductor, which surrounds them in immense volume.

Mr. Isham Baggs, who was for many years connected with the Polytechnic Institution of London, and whose scientific applications of electricity to various purposes have earned for him a just renown, has published a very interesting paper on "The fouling of ships' bottoms prevented by electricity," wherein he shows that the various compositions generally employed for this purpose fail to effect the desired object, and in which he demonstrates the power which can be exerted with proper electrical appliances upon marine animals and plants. Mr. Baggs' experiments and opinions are worthy the consideration of all persons engaged in practical navigation; and we have pleasure in giving publicity to the results of some of his interesting researches. Referring to the cirrhipediæ (of which the common duck barnacle may be taken as a specimen), a sub-family of the class *crustaceæ*, and to whose presence the fouling of the hulls of vessels is in a great measure to be attributed, he says:—

"I obtained a large and close cluster of barnacles, the peduncles being about a foot long, and the whole weighing in the aggregate some thirty to forty pounds. The animals were evidently vigorous and healthy. I placed them in water between the two poles of a battery, lying a few feet apart. I scarcely anticipated any very speedy result, in consequence of the obstruction offered by the cement; but in less than half a minute, the apical portion of the shells opened, the plumose cirrhi protruded, the peduncles gradually lost their firm fleshy appearance, and shrunk both in length and diameter to half their original size, and notwithstanding the inferior conducting power of the half-dry piece of timber to which they were attached, the whole of the animals were effectually killed. Anxious to probe this interesting question still further, and to ascertain if the more completely armed crustaceans were capable of offering any serious resistance to the electric discharge, I took a young and lively crab, in size about sufficient for a moderate man's supper, and placed this in the water, as I had done the barnacles. The very moment I turned the electricity on, the question of defence or no defence was answered, for the animal gave a start so indescribably sudden, that nothing but electricity could have produced it. The creature stood motionless—I broke contact immediately—when the power over the muscles terminating, the crab ran off, faster, perhaps, than ever crab ran before. This convinces me that if even a momentary shock be distributed over a ship's bilge, whatever animals may be there, if only possessed of the faculty of locomotion, as are the larvæ of barnacles, they will quickly and certainly make good their escape to a more placid and genial atmosphere, without waiting for any second notice.

"The attachment and vegetation of marine plants upon the hulls of ships is mainly due in my opinion, and still more in the opinion of practical navigators, to the entangling and rugged surface of adhesion offered to such productions by the accumulation of barnacles and shell-fish. If therefore we prevent the formation of this rugged calcareous surface, by the destruction of the animals producing it—as can most certainly be effected by the electric discharge—we should then also expect to get rid of the marine vegetation which is its consequence; and there can be no doubt such will prove to be actually the result wherever electricity is employed. But let us, for the sake of argument, assume the contrary. Let us suppose that sea-weed is capable of effecting a firm and secure footing upon the otherwise clean surface of an iron vessel, or of a vessel sheathed with copper, or Muntz's metal. The feeble adhesion of the organized material, bound together by vitality, might possibly prevent it from being torn asunder until it was traversed by the electric shock, and then the vitality and cohesion of the mass would give way together; for the effect of life in any organized body is to bind the particles of that body into a concerted whole; the effect of electricity, when in sufficient strength, is to destroy the cohesive polarity, and to *disunite* them. These are only different expressions for well-known phenomena attending life and death, in plants and animals, for the effect is the same in both. Life is strength: death is weakness and decomposition. Now it is a well-known fact, that the passage of shocks through living plants immediately destroys their vitality; and it is further known that a very small quantity of electricity is sufficient for this purpose. A small Leyden jar, containing not more than six or eight inches of coated surface, is sufficient, if sent through the stem of a balsam, instantly to destroy it."

It has long been the subject of anxious study and careful experiment on the part of our scientific men to determine the most useful applications of the electric fluid; and we must certainly congratulate Mr. Baggs upon his marvellous discoveries and ingenious appliances. We have endeavoured in a brief way to show how by means of electricity, the fouling of ships' bottoms, one of the most serious drawbacks to that essential element in navigation—speed—may be easily and effectually removed. The simple mechanical contrivances whereby this important object is accomplished, and which have been patented by Mr. Baggs, may be seen by those who have either the business or the curiosity to enquire. The present application is only another small but a most useful instalment of the benefits which electricity will eventually confer upon mankind—benefits whose ultimate tendency is beyond the scope of human ken, and whose ameliorative power and greatness—

"Lie yet within the unread events of time."

TO ERECT A LINE OF TELEGRAPH.

(*Continued from p.* 52.)

THE Telegraph Act, 1863, being 26 & 27 Vict., cap. 112, is so framed, that it is feared, in offering it to our readers, in a condensed form, we should but mutilate it, without giving its full value. It has already been alluded to as full of information, as well as law, and we will, therefore, only mention specially those sections that provide for certain Forms of Notice or Consent, for the sake of giving the forms themselves, in which they should be rendered.

It is necessary that every notice should be in writing, or print, or partly in writing, and partly in print, and such notice may be given to or by the secretary, clerk, surveyor, or other officer, whether of the telegraph company, or of the body having charge or contract of the street, road, drainage, &c.

Section 8 provides for the security of gas and water mains. Before the position of such pipes is altered, twenty-four hours' notice is to be given to the body to whom such pipe belongs, of the intention to interfere with it.

This notice should be given in the following form:—

To &c., &c.

I HEREBY GIVE YOU NOTICE, that under and by virtue of the power and authority given to the *British Electric* Telegraph Company, by "*The*

British Electric Telegraph Company's Act, 1853," 16 & 17 *Vict., cap.* clix., and by the Telegraph Act, 1863, 26 & 27 Vict., cap. cxii., the said *British Electric* Telegraph Company will proceed, at *three* o'clock in the *fore*noon, on the *fourth* day of *February,* 1864, to open and break up the Road or Way called *Acton Bottom* Road, and leading from *London* to *Uxbridge,* or so much thereof as may be necessary for the purpose of *constructing* (or *altering*) their Telegraphs; and that the said *British Electric* Telegraph Company will alter the position of your pipe or pipes, be they mains or branches.

Dated this day of 1864.

(Signed)
For the *British Electric* Telegraph Company.

Section 10 requires that due notice shall be given before proceeding with the placing of a telegraph under a street or public road. Except in cases of emergency, ten days' notice of underground work, and five days' notice of aboveground work, must be given.

The above form may, in such case, be used, but for underground work, it will be necessary to add:—

"The depth of the underground line will be *twenty-four inches;* the course will be *direct from London to Uxbridge,* and the position throughout will be *in the centre of the pathway.*"

Section 23 provides for the erection of aboveground lines; and *after* the consent of the street or road authorities has been obtained, the following notice has then to be advertised, and publicly delivered at every dwelling-house on the route proposed to be taken, at least twenty-one days before proceeding with the work:—

UNIVERSAL PRIVATE TELEGRAPH COMPANY.

Incorporated by Special Act of Parliament, 1861.

Pursuant to the Provisions of an Act of Parliament made and passed in the Twenty-fourth Year of the Reign of Her present Majesty Queen Victoria, entitled the "*Universal Private Telegraph Act,*" 24 *Vict., cap.* 61, and also of an Act of Parliament made and passed in the Twenty-seventh Year of the Reign of Her present Majesty Queen Victoria, entitled the "Telegraph Act, 1863," 26 & 27 Vict., cap. 112.

Notice is hereby given, that the *Universal Private Telegraph Company,* having obtained the consent of the body having the control of the street or road hereunder mentioned, and of the other persons whose consent is required, by their own, and the said Act respectively, intend to construct a line of Telegraph along the road or highway leading from *Littleborough to Rochdale,* and for that purpose to set up and erect poles and other apparatus connected therewith, by the side of, over, along, or across the said road or highway, in accordance with the powers granted by the said Acts respectively, some or one of them.

One Form of Consent will serve to carry out all the intentions of the Act; this should bear a sixpenny stamp, and it is usual to have two copies signed and exchanged between the two contracting parties.

Agreement made this *fourth* day of *February,* One thousand eight hundred and sixty *four,* between *John Williams, Manor House, Maidenhead,* in the County of *Berkshire, Farmer,* of the one part, and *Frederick Jones,* Secretary of and acting for and on behalf of the Telegraph Company, hereafter called the Telegraph Company, of the other part.

The said John Williams permits the said Telegraph Company to carry their Telegraph across his property, situated at Pinkney's Green, in the County of Berkshire, and to affix their poles and wires to the said property, and to allow the said Company, their servants, and agents, to enter upon the said property, from time to time, as there may be occasion, for the purpose of repairing, altering, and removing the said Telegraph, the said Company hereby agreeing to pay the said John Williams the sum of per annum, for so long as they shall continue to use these privileges, the said sum to be paid in advance, and the first payment to be made on the *twenty-fifth day of March,* One thousand eight hundred and sixty four. And, further, the said Company undertakes to remove the said Telegraph Poles and Wires from off the said property within six calendar months after the said John Williams shall have given them a written notice, requiring them so to do.

As witness our hands,

(L.S.)

(L.S.)

THE INTERNATIONAL EXHIBITION, 1862.

(*Continued from p.* 67.)

J. Rogers (United Kingdom, 2,950), exhibits specimens of insulated wire with hempen cords ingeniously plaited round the core, so as to give considerable strength and lateral protection combined with great flexibility. The rope, moreover, is free from any liability to kink. This form of cable seems well suited for some purposes; for instance, it might be used in connection with chronoscopes, electric targets, &c., where short lengths of insulated wire have to be frequently moved from place to place, but it is unsuited for submarine cables. Although strong, it admits of considerable extension, and any accidental strain on the cable might stretch the core.

The teredo, which has been already mentioned as almost invariably attacking unprotected hemp, would very shortly strip the core of the strengthening cords, leaving a bare core which could never be recovered, and might probably be injured by the animals; the hemp, by fostering these animals, instead of a protection, may become a source of danger.

Wells & Hall, H. M. (United Kingdom, 2,988), exhibits a deep-sea cable, in which the outside wires lie parallel to the core. They are held in their place by an ingenious plaiting of hemp, which entirely surrounds each wire and gives the whole cable the appearance of being covered with hemp alone. This cable will bear a great strain without stretching; it is not liable to kink, and could be easily laid in almost any depth; it would not be, however, more permanent than the Toulon-Algiers form already described.

C. Duncan (United Kingdom, 2,896) exhibits specimens, in which the usual iron wires are replaced by ratan canes; it is stated that a cable of this form one inch in diameter will bear upwards of two tons, and weigh less than three-quarters of a ton per mile. It is a comparatively easy matter to design a cable which can be safely laid in any necessary depth, without having recourse to short pieces of cane as a covering. The difficulty is to find a permanent material, which shall retain its strength and continue to afford protection after the cable is laid. Mr. Duncan, from experience obtained with ratan ropes in China, believes that cane would be found more permanent than iron wires. The writer cannot share this opinion, but owns that he is ignorant of the special properties of cane. Mr. Duncan states that he has successfully overcome the serious difficulties of the manufacture.

E. B. Sharpe (United Kingdom 2,956) exhibits specimens of submarine telegraph cables, in which the usual outer spiral, or rather helical iron sheathing, is replaced by a sheath of straight wires kept in their place by a serving of hemp or iron, or both combined. This invention is designed to meet the following supposed defect. It is argued, that as an open spiral or rather helix of a single wire elongates with the smallest strain, so a cable covered with a series of these helices must elongate in a similar manner, to the great detriment of the contained core. In this age, when experiment is so highly esteemed, it seems incredible that this statement should have received the support and credence which has been accorded to it even in some scientific journals. The fallacy becomes almost tangible when a specimen of the usual cable is simply handled; and direct experiment shows that a well laid-up cable of the usual form hardly stretches more than a solid bar of iron under corresponding strain. Thus, experiment made for the Government by Messrs. Gisborne & Forde, and Mr. C. Siemens, show that the Red Sea cable, covered with eighteen wires of about 0·74 in. diameter, bore from 70 to 80 cwt., and stretched from 0·56 to 1 per cent. before breaking, while single wires a little larger in diameter bore from 4 to 4½ cwt. and stretched from 0·4 to 0·52 per cent. before breaking. It will readily be seen that the open coil or helix, extends by diminishing in diameter, whereas the wires of a cable put up one against the other, forming a complete circle, the diameter of which cannot diminish unless each circular iron wire could be squeezed oval—in fact, each wire may looked on as a segment of an arch defying any compression applied equally on all sides. The slight extra extension observed in the cable as compared with the solid rod, is due to a slight diminution of diameter produced by the more perfect closing of the wires under the strain; the better the rope is laid-up, the less this will be. No lateral compression, nor longitudinal strain of any consequence ever comes on the soft extensible core of the cable; indeed, the great merit of the present iron-sheathed cable is the perfect protection afforded to the core against mechanical injury.

Mr. Sharpe's bundle of straight wires could be far more easily squeezed out of shape than the usual rope; it would be less flexible, and would stand far less of the hard usage to which cables are necessarily subjected: it would be less liable to kink, but the danger from this cause has been enormously exaggerated.

4. *Paying-out Apparatus.*

Mr. Sharpe also exhibits a model of some machinery for paying-out cables. This model more properly belongs to Class VIII.; and as the opinion formed of it was not very favourable, the writer omits, at Mr. Sharpe's request, the description he had prepared.

5. *Insulating Materials for Submarine Cables.*

Gutta-percha and india-rubber are the only two materials which have hitherto been used for the insulation of submarine conducting wires.

S. W. Silver & Co., M. (United Kingdom, 2,960), exhibit specimens of wire insulated with india-rubber; and one specimen a mile in length, formed part of a core manufactured in 1860, and favourably reported on by the Committee of the Board of Trade on Submarine Cables. They also show specimens of a rope about ¾ of an inch diameter, containing fifty insulated wires, and used with success by the Universal Private Telegraph Company, for over-house work in London and elsewhere. Messrs. Silver cover their wire by lapping a series of tapes round and round the copper wire, and they consolidate the mass by subjecting it to the temperature of boiling water for about half an hour.

Wells & Hall, H. M. (United Kingdom, 2,988), also exhibit various specimens of wire insulated with india-rubber, one of which represents the core of a short cable about to be laid in the Persian Gulf.

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit a wire insulated in the first instance by india-rubber, and then covered with gutta-percha. Their india-rubber is applied very ingeniously by a machine exhibited in Class VII.

The process depends for its success on the property of two freshly-cut surfaces of india-rubber to adhere when brought together under considerable pressure. Two long tapes of rubber are laid along the two opposite sides of the conducting wire; their edges are cut and immediately afterwards they are pressed round the copper wire by rollers; the edges join under the pressure so as to make a continuous cylindrical cover with two straight longitudinal joints running the whole length of the wire. Two or more of these coatings are applied with the joints in different planes, and the whole is then covered with gutta-percha by the usual die process. By this plan the india-rubber is neither heated nor stretched, and the spiral channels, which are to be feared in the lapping process, are altogether avoided.

India-rubber tapes, when first applied to the insulation of wire, were cemented by means of solvents; but the covering thus made decayed very rapidly. Heat was next adopted to unite the mass, but many specimens so prepared are found under many circumstances to become sacky, *i e.*, to turn into a sticky semi-fluid substance, not only outside, where exposed to the air, but inside next the copper. The cause of this change is by no means well understood. Some say it is due to the process of mastication, by which the india-rubber is prepared before being cut into tapes; others, that the heat used to cement the various layers is to blame; others, that the tension of the tapes while they are being wound round the wire alters the structure of the material; some look for the source of danger in some chemical action on the copper with which the india-rubber is in contact, and it is probable that tinning or varnishing the copper does to some extent prevent the change described. Chemical analysis has hitherto given but little clue to the nature of the change. Messrs. Siemens' india-rubber applied cold, without tension, so far as the writer knows, does not turn sticky; but unless covered with gutta-percha, the longitudinal joints are liable after a time to open.

W. Hooper, H.M. (United Kingdom, 2,915), exhibits specimens of a manufacture, by which it appears that the "tackiness" of the india-rubber is prevented. He first coats his copper with the usual lapping of india-rubber tape; he then covers this india-rubber with what he calls a separator, which may consist of tinfoil, iron wires, oxide of zinc, &c. Outside this he applies india-rubber, mixed in various proportions with sulphur. He then subjects the whole for some time to a temperature sufficiently high to vulcanise the outside covering. This temperature would reduce unprotected pure india-rubber to a mere semi-fluid, useless mass, but when protected as described, the inner india-rubber is cemented into a compact solid mass, retaining no trace of the original subdivisions or joints. The use of the separator is to prevent the sulphur from affecting the inner india-rubber to such an extent as to injure the copper, or, perhaps, to impair the insulating properties of the material.

Mr. Hooper does not look on the outer hard or soft vulcanised india-rubber as of much use in the insulation, when wires intended to give strength are used as the separator. It is to be regretted that this process should hitherto have been applied apparently only to very short specimens. It would appear difficult to make joints, as the condition of the outer covering must depend on maintaining exactly the right temperature for exactly the right time; and the inner coating cannot be manufactured without the outer coating. Mr. Hooper claims to have overcome this difficulty. It remains to be seen in practice whether, in overcoming one defect, Mr. Hooper may not have introduced fresh dangers, arising from the very complication of the process.

The Gutta-Percha Company, M. (United Kingdom, 3,000), exhibit specimens of the cores, or insulated wires, which they have supplied for fifty-one submarine cables during the past eleven years. Some of these have failed, and undoubtedly some of the failures have been due to bad insulation caused by defective manufacture, or improper treatment after manufacture.

Much skill is required to make a good joint between two distinct lengths of covered wire or core. The copper conductors of the two lengths are soldered together, and the gutta-percha covering of the bare joint is applied by hand. If the gutta-percha used for this covering is overheated or dirtied, or in any way unskilfully manipulated, the adhesion between the new and old materials is imperfect, and the joint, although it looks well and tests well at first, gradually opens so as to admit the water to the copper. This fault is enlarged by the action of the voltaic current. The copper is gradually eaten away; it finally separates altogether, and the signals can be no longer transmitted. Joints made at leisure by experienced workmen are as sound as any other part of the core; but the apparent ease of the process sometimes tempts novices to try their hands with fatal results; and undue haste at sea sometimes causes the work to be slurred. There is no reason to suppose that fewer joints would be required with india-rubber covered wires, or that they could be made with less risk of failure. On the contrary, solvents are sometimes used to make these joints, although their use has been abandoned for the general manufacture.

Numerous air-holes have been found in some gutta-percha cores. These cavities, under pressure, become filled with water, and sometimes, under the action of powerful currents, are developed into faults or holes, which establish a communication between the conductor and the sea. It is believed that the Gutta-Percha Company have in the later cables entirely avoided this defect.

Gutta-percha becomes plastic at temperatures slightly exceeding 110 deg. Fah., and some injuries have occurred from this cause; it is also a soft substance, which can easily be cut or otherwise mechanically injured. The two first-named defects are practical defects, and would never have been discovered if only short specimens had been made.

The merits of the material are so great that it can well bear to have its imperfections disclosed. More than 20,000 miles of wire insulated with gutta-percha have now been submerged; many hundreds of miles have been again pulled up after remaining submerged in different parts of the world for several years in shallow water, and in depths of 1,000 and 1,500 fathoms, but not one yard of the recovered cable has been found to have decayed. Gutta-percha cores can be bent, kinked, and even knotted, without receiving any injury of importance, and the electrical qualities of the material, always valuable, have lately been wonderfully improved by the manufacturers. To show the perfection to which the manufacture has been brought in a mechanical point of view, the Gutta-Percha Company exhibit some copper wire $\frac{1}{350}$th of an inch in diameter, covered with gutta-percha to $\frac{1}{16}$th of an inch diameter. This very fine covered wire weighs about 1 lb. per knot. They also exhibit a sheet measuring 12 feet by 10 feet, and weighing 30 grains per square foot.

The cores of almost all the cables named in table C were supplied by this company.

The Board of Trade Committee found that the insulation obtained from india-rubber prepared by Messrs. Silver was twice as good as that given by the usual specimens of gutta-percha—but thereupon

a specimen of gutta-percha was produced which equalled the india-rubber. Tests recently made by the writer seem to show that gutta-percha, as now prepared, is the better insulator of the two. The word insulation is here used in the limited sense of high electrical resistance. A material (for instance, glass) might be spoken of as the best insulator, without its by any means following that it was the best material for the insulation of submarine wires.

The annexed table D gives the data on which the above statement is founded. The headings of all the columns but the last sufficiently explain their meaning. The last column contains the specific resistance of the material insulating each cable; it would be constant if all the materials had been alike. The specific resistance is the resistance of one cubic foot to conduction between two opposite faces. The higher the figure the better the insulator. It will be seen that Messrs. Silver's material has twice the specific resistance of that used for the Red Sea cable, and that the gutta-percha of the Malta-Alexandria cable has nearly twice the resistance of Messrs. Silver's india-rubber.

TABLE D.

NAME OF CABLE TESTED.	Copper Conductor.				Insulator.				Approximate ratio $\frac{D}{d}$ *	$\log_{\epsilon} \frac{D}{d}$	Insulation Resistance per knot, R, at 60° Fah. in Siemens' large mercury units after electrification for one minute.	Specific Resistance $\frac{2\pi R L}{\log_{\epsilon} \frac{D}{d}}$ (L = 6082 feet.)
					India-rubber.		Gutta-percha.					
	Diameter of single Wires in inches.	No. of Wires in Conductor.	Total weight in lbs. per knot.	Total diameter of Conductor=d.	Weight in lbs. per knot.	Diameter in inches=D.	Weight in lbs. per knot.	Diameter in inches=D.				
Red Sea Cable, tested by F. Jenkin before being laid	0·038	7	180	0·105	—	—	212	0·34	3·4	1·224	98·8	3,080,000
Malta-Alexandria, standard tested by Siemens	0·054	7	400	0·162	—	—	400	0·457	2·95	1·082	332·0	11,700,000
Wire covered by Messrs. Silver, intended for a channel line	0·024	7	86·5	0·071	115	0·232	—	—	3·48	1·233	212·0	6,572,000
Specimen, covered by Messrs. Siemens with india-rubber and gutta-percha, tested by Messrs. Siemens	—	1	42·5	0·059	12	0·100	16·2	0·136	2·3	0·833	106·0	4,863,000
Second specimen	—	1	42·5	0·059	12	0·100	35·0	0·168	2·85	1·047	460·0	16,780,000

The question of the relative merit of the two materials in this respect, though much vexed, is absolutely without importance. They both insulate well enough for every practical purpose. This will readily be allowed when the following fact is known. The current received through 2,000 miles of the Malta-Alexandria cable, maintained at 60 deg. Fah., would be only 0·7 per cent. less than that received through a cable perfectly insulated, or, in other words, covered with a material of infinite resistance.† If the cable, instead of being kept at 60 deg., were in warm latitudes, and maintained at 75 deg. Fah., the difference between the actual cable and perfection would be 2¼ per cent., instead of 0·7 per cent. Any further improvement in insulation can only serve to reduce this trifling per centage.

The insulation, when so good as this, has little or no effect on the speed with which successive signals can be transmitted through a cable. This speed depends on a second electrical property—viz., the specific inductive capacity of the insulator; or, in other words, on the relative magnitude of the statical charge which would be induced from the same source in Leyden jars of equal dimensions, with the dielectric made of the several different insulating materials.

In this respect, india-rubber is certainly better than any gutta-percha which has yet been produced. The annexed table E gives the results of some experiments made specially for this report by the writer. The last column contains the specific inductive capacity of each material compared with air taken as unit; the lowest number corresponds with the best material and the number of words which could be transmitted per minute through wires of equal dimensions, insulated with these several materials is simply inversely proportional to the numbers there given. Some experiments on old cables lead to the belief that the specific inductive capacity of the material then used was greater than that of the present gutta-percha. The correctness of the absolute values as compared with air depends on the accuracy of some of Professor Weber's experiments, but the relative values are unaffected by these experiments, and can be relied on. Messrs. Silver's wire was the best of those tested. Messrs. Siemens' wire was covered in the first instance with a small quantity of india-rubber, and then with a thicker coating of gutta-percha.

TABLE E.

NAME AND LENGTH OF CABLE TESTED.	Copper Conductor.				Insulator or Dielectric.				Approximate ratio $\frac{D}{d}$ *	$\log_{\epsilon} \frac{D}{d}$	Electro-statical capacity C of one foot in electro-static absolute units.‡	$I = 2C \log_{\epsilon} \frac{D}{d}$ Specific inductive capacity.
					India-rubber.		Gutta-percha.					
	Diameter of single Wires in inches.	No. of Wires in Conductor.	Total weight in lbs. per knot.	Total diameter of Conductor=d.	Weight in lbs. per knot.	Diameter in inches.	Weight in lbs. per knot.	Diameter in inches.				
Specimen of wire covered by Silver, 9½ knots long, intended for a channel line	0·024	7	86·5	0·071	115·0	0·232	—	—	3·43	1·233	1·144	2·82
Specimen of Messrs. Siemens' wire, 1,657 yards long	0·0295	4	43·0	0·059	13·0	0·114	52·25	0·177	3·00	1·100	1·38	3·036
Second specimen of Messrs. Siemens', 329 yards long	0·037	3	51·0	0·057	26·4	0·13	102·4	0·266	3·72	1·314	1·187	3·12
Specimen of gutta-percha tested at Messrs. Siemens', 1,758 yards long	—	1	82·0	0·066	—	—	80	0·206	3·121	1·138	1·837	4·18

Rattier & Co., Paris, H. M. (France, 1,428), exhibit some creditable specimens of gutta-percha covered wire, protected with lead, and with iron wire in the usual manner, for land and submarine purposes respectively.

(To be continued.)

* Where the conductor is a strand, d has been diminished 5 per cent. before taking the ratio $\frac{D}{d}$.

† Resistance of copper conductor per knot = 3·65 mercury units. Resistance of gutta-percha sheath per knot = 332,000,000 mercury units.

‡ These numbers are equal to the radius of a sphere of equal capacity to that of one foot of the cable: that is to say, a conducting sphere of this radius insulated in the interior, and very far from the inside, of a large hollow conductor, would hold the same charge as one foot of the cable when the difference of potentials between the sphere and surrounding conductor is equal to that between the internal wire of the cable and the surrounding water.

ON THE GAS BATTERY OF MR. GROVE, AND ITS THEORY.*

HAVING had during the past summer occasion to review minutely the theory of the voltaic pile, I was, by the nature of my work, led to go somewhat fully into an examination of recorded facts and observations in regard to the whole subject; and this by various writers, chemical and electrical, old and modern. The results of my inquiry and attendant experiments have compelled me to lay down different interpretations of the origin of the power and nature of the phenomena of the pile, from those usually adopted by the advocates of the chemical and contact theories, or of the theory of Davy, which makes both contact-electrical and chemical action essential to the origin and continuance of the current. Nevertheless, I may in passing observe that, with an important qualification as to the origin of the electric agency, I incline to a revival of the latter theory. My reasons for doing so will be apparent a little later. I know, however, that with respect to the theory of the voltaic pile, speaking generally, I dare not at present express fully my scientific convictions, since the facts on which I rely are in part second-hand, and, although the work of eminent men of former days, may be thought by some to need revision on account of our extended knowledge. At the same time it is right to say that I have no doubt as to the consequences of such revision. But with regard to the gas battery considered by itself, I have no such cause for hesitation; there everything of a chemical and electrical nature essential to the inquiry is apparently so open and under control and ready observation, that I do not see that I need, as to my facts and views on this subject, shrink from an appeal to the judgments of the competent readers of this eminently philosophical publication.

The gas battery of Mr. Grove, as most readers are aware, consists of a series of cells, each containing two tubes of glass sealed at one end, and in which are inserted by fusion long narrow platinum plates and attaching wires, the plates reaching a little below the bottom of the tubes. These tubes are partly immersed by means of a ground collar into a square three-necked Woulfe's bottle, the centre hole between the tube-holes being stoppered. The tubes are usually two-thirds filled—the one with hydrogen two volumes, the other with oxygen one volume—the bottle and remaining part of the tube holding the usual dilute sulphuric acid to complete the circuit. The platinum is, in order to promote contact with the respective gases and the liquid, covered with platinum-black; metallic contact between the tubes or to the galvanometer is made by mercury cups attached to the platinum wires. I have been thus particular in describing the form of cell, because my case rests upon the results obtained by a pair which I have constructed and charged in a similar manner in all apparent essentials, with only one important difference (as the fact turns out), namely, omission of the platinum-black. In my pair I simply use plain clean platinum, first burnished with agate and then further cleansed with tripoli, ammonia, and spirits of wine; so that it is chemically and electrically clean, as experiment easily shows. Thus far premised, and all being arranged, I proceed to experiment with each instrument. With Mr. Grove's pair, which I will call A, I get of course a powerful deflection with an ordinary good galvanometer; with the plain platinum pair B, none. The A-tubes left in metallic contact for some time show a tolerably rapid disappearance of the gases. The B-tubes left in contact for the same time, no sensible disappearance. But, more than this, the A-tubes left without voltaic metallic contact show a rather rapid rise of fluid, especially in the hydrogen one. The B-tubes in a parallel experiment, in which the time is not too long, show no alteration of level, but after several days a little hydrogen has disappeared: this I attribute to the difficulty of burnishing the edges of the foil used.

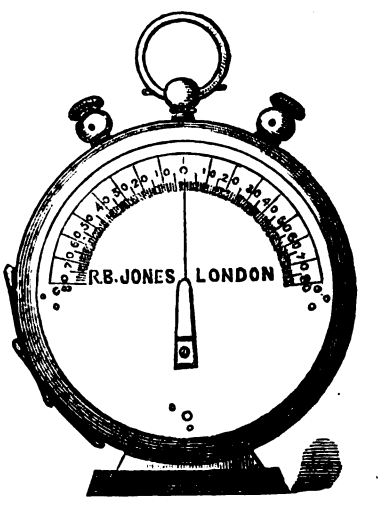
The whole of the facts needed for our purpose are now before us. There is, as might have been foreseen, evident chemical union of free gaseous particles, obtained by diffusion, in the tube containing platinum-black, and none sensibly in the plain platinum tube; and since in the one case there is a current following metallic contact, and in the other none, it follows, I humbly submit, that antecedent static electric action, produced here, I admit, by chemical action (but of direct combination, and not of indirect with simultaneous decomposition), is necessary to produce true voltaic phenomena. Contact in the wire, or disruptive discharge in the air, or convection in an external decomposition cell, restores the disturbed equilibrium of the chain. The fluid below, being part of the chain, suffers decomposition as a consequence of the discharge above, and, as Davy would allow, the now liberated gases react directly upon the free gases in the tube; and so a constant supply of active material is furnished for the production of fresh electricity, and hence the appearance of a current and of circulation. The antecedent chemical action and statical spark are no longer necessary, unless contact be broken, when all reverts to the original state, and the diffused and dissolved gases are again in requisition. Fresh contact, by allowing discharge of static electricity, will again renew the voltaic or galvanic phenomena.

Such I believe to be a true and philosophical account of the facts and consequences concerned in this remarkable instrument; and I venture to think it is one that will apply also to the water and salt-and-water excited battery, if not to the acid battery itself. Thus the rival theories find their place and application, but not in the order or manner supposed by their first and illustrious enunciators, Volta, Wollaston and Davy. If truth is found in these facts and views, chemists and electricians will readily see that such topics as passive iron, rusting of metals, and decay, and even general chemical action itself, may yet receive further elucidation from viewing them in the manner here attempted in the case of the gas battery. I may at once mention that the anomaly of free hydrogen being found with the nitrogen in some of Mr. Grove's eudiometric experiments become perfectly intelligible and regular by the considerations here evolved.

I am indebted to Mr. Gassiot, whose known kindness needs no comment, for the use of the Grove gas pair, and also to Dr. Wrigley for permission to carry on my experiments in his laboratory, aided by his instruments.

* By T. A. Malone, late Director of the Laboratory, London Institution.

JONES'S PORTABLE GALVANOMETER.



THIS is a very elegant, compact, and useful instrument for testing telegraphic wires, or for experimental purposes. From its small size, it can be conveniently carried in the waistcoat pocket, not being larger than a moderate-sized watch, which it resembles in appearance. Its diameter is about 1¾ inch, and its thickness ½ inch. It is furnished with a small ebonite stand, terminals, and a loop, to which a chain or guard may be attached. The coils are formed to suit the case, and are so arranged also as to have a greater electrical influence on the needle or magnet than the ordinary coils. The coils consist of considerable lengths of fine copper wire (No. 35). The needle is so placed within the coil that it can be magnetised when required without the necessity of removing it from its position. The instrument, from the smallness of its size and the perfectness of its arrangement, will, we have no doubt, be appreciated by engineers and practical electricians who superintend the construction and working of telegraph lines. It has been designed and constructed by Mr. R. B. Jones, electric telegraph instrument manufacturer, of 14, Nelson-terrace, City-road, E.C.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY (LIMITED)

The ordinary half-yearly general meeting of the shareholders of this company was held at the London Tavern, on Friday, the 5th inst., for the reception of the report of the directors, and the transaction of the general business of the company; Henry Moor, Esq., chairman of the board, presided on the occasion.

The Secretary having read the notice calling the meeting, and the report having been agreed to be taken as read,

The Chairman remarked that he had very little to say to them on that occasion; the company was in a prosperous condition, their cables were all right, and their traffic considerably increasing. Comparing the receipts of the current half-year with the last, they were very much better, being as £7,000 against £5,400; their weekly receipts being about £269 on the average. During the half-year there had been a break in the cable, between Alexandria and Malta which, however, had been made good, and had it not been for this, it was most likely that their receipts would have been double the previous, but he was sorry to say that another interruption had occurred on the same line; the lessees, however, had sent out a vessel to repair it, and, as the damage had occurred in shallow water, it was believed that it would very speedily be in working order again. Their receipts during the past half-year amounted to £437 more than the previous half-year, and it was a gratifying fact to be able to show that their staff was able to perform the work they had to do, however much that might be increased, whilst their expenses had increased only about £29, a sum hardly worth mentioning. A disadvantage the directors had had to contend with, was the fact that they could not get a proper settlement with the Italian government; they had only received payment for the quarter ending March, 1863, and there were now three quarters due from them, which they had a great difficulty in obtaining, and as they had to declare a dividend, they would have to borrow money of their bankers, for the purpose of paying it. The directors had done all they could to bring the Italian government to a settlement, and, not having succeeded, they had now applied to the Lords of Her Majesty's Treasury on the subject. The payment of a dividend of 4 per cent., free of income tax, and the sum agreed to be carried to the reserve fund, would absorb nearly the whole of their receipts for the past half-year, therefore the only way open to them for the payment of their dividends, was the plan proposed. He would now move "that the report and statement of accounts now presented, be received and adopted."

Sir James Carmichael seconded the resolution.

A Shareholder wished to know the meaning of the last item in statement of expenditure, "deduct Alexandrian lessees' proportion of rent for Malta offices, £23 19s. 9d."

The Chairman, in reply, said that last year there was an agreement between the company, and Messrs. Glass & Elliot, that they should share half the expenses of working the line, but, that agreement having expired, they thought that they would prefer keeping their own staff, which they have accordingly done.

The same Shareholder wished to know why interest should not be charged to the Italian government for the amount due, as they would have to pay interest to their bankers, if they borrowed money to pay their dividends, besides putting them in an unenviable position before the public?

The Chairman said that they could not claim interest on the account. It must be borne in mind also, that although they did not receive interest from the Italian government for the money they owed the company, neither did the company pay interest to those to whom they were indebted, otherwise they would have to pay on about £13,000 owing by them to other companies. If, however, the directors could get the opportunity of enforcing the payment of interest on the amount, they would not fail to do so. (Hear).

No other remarks having been made in relation to the report, the motion for its adoption was put, and carried unanimously.

The Chairman then moved "to declare the usual dividend at the rate of 8 per cent. per annum, on the preference shares, subject to the deductions for income tax," which, having been seconded, was carried unanimously.

The Chairman next moved "that a dividend of 4s. per share, equal to 4 per cent. per annum, free of income tax, be declared on the original shares," which, having been seconded, was also carried.

The Chairman then remarked that he had then come to an important resolution, which they could please themselves as to whether they would carry or not. In order to pay the dividend which they had just declared, it would be necessary that the directors should borrow the money to pay it with, and the amount they would require would be about £3,000. He had therefore, to propose "that the directors be empowered to borrow of their bankers, a sum sufficient to pay the dividends now declared," which, having been seconded,

A Shareholder said, that he should like to be informed when they were likely to receive their account from the Italian government, as he would much rather stop a little while for his dividend than that the money should be borrowed to pay it with; he had a great objection to borrowing money, especially for such purposes, and if they were likely to obtain a settlement shortly he would rather that the payment of the dividend be deferred.

The Chairman said that it was quite out of his power to say when the settlement would be made, he could only say that the directors would do all in their power to obtain it; it might be in a few days, or it might be much longer; the loan would not be taken for a fixed period, but merely as a current loan.

Mr. McDougal said that it might prove very disastrous to some of their shareholders not to receive their dividends at the usual time; some of them might be in poor circumstances, and were depending upon this money, and he thought it would not be well to disappoint them; the money had been earned, and was still owing, and would be sure to come, therefore it would make but little difference to them, and he considered that there could be no objection to borrowing it.

The motion, having been put to the meeting, was carried in the affirmative.

The Chairman then moved "that an amount of £700 3s. 4d., being 10 per cent. on the revenue, be carried to the reserve fund." At present they only had £547 16s. 7d. invested on the reserved fund account, arising from the fact of not having received their money from the Italian government; when the whole of their money was received from the Italian government, it would amount to about £1,700.

The business of the meeting having been declared by the chairman as having been brought to a close,

Mr. McDougal said that the meeting had yet a duty to perform towards their chairman and directors, he should therefore move that "the thanks of the shareholders be presented to the chairman and directors, for the manner in which they had conducted the business of the company during the past half-year."

Mr. Wisby, having seconded the proposition, it was put and carried unanimously.

The Chairman, in acknowledging the compliment on behalf of the directors and himself, remarked that they were glad to have met them under such favourable circumstances, and hoped that their next meeting would be much more so.

The meeting then separated.

ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY (LIMITED.)

The twenty-sixth half-yearly ordinary general meeting of this company was held at the offices of the company, Telegraph-street, Moorgate-street, E.C., on Thursday last, and was very numerously attended. The Hon. Robert Grimston, chairman of the company, presided on the occasion.

The Secretary having read the advertisement calling the meeting, the Chairman said that it was his duty now to lay on the table the register of the proprietors of the company, and affix the seal of the company thereto.

The report as printed and circulated having been taken as read, the Chairman said, that, eighteen years ago, Messrs. Cook and Ricardo, with a few other individuals, undertook to teach the world a new art, with what success the world now knew. They had to make experiments in all matters, and in what that company had done they had been servilely imitated. Compared with what that company had done for telegraphy, others had done but very little; and he felt that the public owed them a debt of gratitude for what they had accomplished. When the company was first started, the price charged for the conveyance of messages was a very high one; but as telegraphic communication became more known and appreciated, the company reduced their scale of charges to the public. In 1850, the maximum charge was 10s. for a message, it then was reduced to 8s. 6d., afterwards to 5s., and so on; and this course has been adopted ever since by the directors as necessity called for it. The tariff is found to require occasional revisions, and this has the special attention of the directors, and in all cases they cannot get through without a loss; but the profits made on some portions of the line make up for the losses on others. When they came to analyse the receipts, they find that one-fifth of the income arises from the Irish traffic. In undertaking this portion of the business, they entered upon it with doubting and hesitation; but having begun it they found that they must go on with it, even to the South of Ireland: they were doing their work there right well, and the business increases steadily. One-third of their income was derived from Continental traffic. The plan adopted by the Government of what is termed the Austro-Germanic Union, has caused a reduction of the tariff all over the Continent; but the tariff of this company remains as it was before, whilst its business has increased, and it can only be limited by their capability of carrying messages. As to their general and home system, they have stations all over the country; other telegraph companies have not the means which this one has at their disposal, and no opposition can materially affect them. The expenditure for the last half-year has been large; but if a large amount of work is done, the expenditure will crop out in the shape of wages, stationery, gas, &c. But in order rightly to judge of the matter, they must compare the expenses with the amount of work done, they will then see that the expenditure has been kept at the lowest point, the receipts now showing more than 100 per cent. in their favour. Another item called for remark, and that was the cost of maintenance; this their engineer had gone into. Now if any one was about taking a long walking tour, he would not start

with shoes partly worn out, but would see that they were in perfect order, or he would soon be compelled to come to a stand; just so it was with telegraph lines,—unless they were repaired effectually and maintained efficiently they would soon break down, and loss would result. The shareholders had a right to know that they had their money's worth for what they had expended during past years; and he thought that their Electrician's report furnished them with that information. During the violent gales which occurred in November their system was tested very severely, but their working was never interrupted; and after each storm the report of their superintendent on the state of their lines was most satisfactory. If their income is to amount to £137,150 during a half-year, it can only be done by an efficient and costly system. With their balance of £50,000 they should not only be able to pay their dividends, but have sufficient to resuscitate their reserve fund, which was a matter of great importance, for business was subject to very many vicissitudes, and it was desirable to be prepared for them. There might be a great continental war, and their business might be considerably interrupted, and thus their receipts might fall short; but if they had this fund to fall back upon, however protracted the war might be, they would not feel its effects to such an extent. He felt that they must be thankful for such a prosperous half year, which had enabled them to place their property in so good a position. He must call their attention to the capital account. A portion of that building was on freehold, and another portion on leasehold ground, the lease having seventy years to run. Your directors are desirous of making the property their own, and for this purpose they write off £800 per annum, in order to accomplish this, and in twenty years they will stand rent free. Until the last half year they adopted a similar course in regard to their central offices in Founder's-court, which they had now disposed of. In the earlier days of the company it was, perhaps, necessary to have large and attractive premises, in order to draw the attention of the public; but the directors considered that as the company was now so well known they might do with less expensive premises, and consequently they had removed here, where they had their galleries constructed, and were able to carry on their business equally well, whilst they have been relieved of a ground rent of between £300 and £400 a year, and the £5,839 which was due to the company at their former meeting for the sale of their premises the directors have now placed on deposit, and propose, with the sanction of the shareholders, to add to the reserve fund. It has been the lot of the directors mostly to report the death or removal of some one of their number, and they have to do the same now, in announcing the death of one of their oldest and most valued members, Mr. Thos. Critchley, and the resignation of the Right Hon. Sir John Lawrence, on account of his appointment as Governor-General of India; and as the board now consists of fifteen members, we do not propose to fill up the vacancies, and have passed a resolution to that effect, as they were empowered by the Company's Act. He had further to inform them of a change in the principal officer of the company. Mr. Fourdrinier, who had filled the office of secretary to the company for the last fifteen years, and had served them faithfully and zealously, had now retired from that office, and he should have to ask them to grant him a retiring pension of £300 per annum. He would now move the adoption of the report.

MARK HUISH, Esq., seconded the motion.

Mr. REID wished to know whether 5 per cent. was paid on the £75,000 debenture stock. (The Chairman—4½ per cent. is.) He could not understand how it was that the accounts were presented so long after the quarter had closed, and that so many weeks were allowed to pass by before the half-yearly meeting was held. If the accounts of a great country like this could be made up in a few days, he could not see why the accounts of this company could not be furnished sooner.

The CHAIRMAN said that nothing would be easier than to have their meeting two or three days earlier, and to get their accounts out sooner—it was a mere question of expense; but they must employ extra clerks, and it would entail an outlay of several hundred pounds, which they considered to be unnecessary. Their other meetings had fallen about this date for several years, they had got into that groove, and he thought that no inconvenience arose from it. With respect to the debenture debt, it was a portion of new capital, and it would be a very unusual course to pay off capital out of revenue. These debentures were borrowed for a term, and they had not the option of paying them. They were getting more than 5 per cent. for their money.

A SHAREHOLDER wished to draw attention to the paragraph in the electrician's report as to the insulation of the wires. This insulation had been a very serious thing from beginning to end. When Mr. Clark was going to upset the whole insulation some time ago, it cost the company some thousands of pounds, and now it was proposed to have a new system of insulation. He should like to know what was intended to be done, as it would cost them a large sum of money.

The CHAIRMAN was sorry that the electrician was not present to answer for himself, being unfortunately laid on a bed of sickness; but he believed that he was fully justified in putting that paragraph in his report, concerning the insulation, for the average time in which a message was sent to Cork from London was two minutes. The insulator used was brown earthenware, composed of three parts, and put together with an ebonite pin: it cost about half the price of any other, and was the best, costing about 6d.

A SHAREHOLDER wished to ask a question about their submarine cables. At a former meeting the Chairman had announced with much *éclat*, that the directors had dispensed with the steamship, *The Monarch*, but he found that they were in for it again, for £2,354. He wished to know whether *The Monarch* had really been dispensed with or not.

The CHAIRMAN: No, it was not; for ships would drag their anchors, and it was necessary to have a vessel at hand to repair the cables.

Mr. LANG wished to know when the contracts with the railway companies expired. The stores in hand were put down at £50,375. Was it necessary to keep so much on hand, or might not some of it safely be disposed of? The amount of £72,613 due, seemed to be a very large one; was it not possible to reduce it? And what was the policy the Board intended to adopt in competing with the Magnetic and other companies?

The CHAIRMAN said, he was asked whether it was necessary to keep £50,000 of stores on hand? It was absolutely necessary to have a very large amount on hand; it has been very much reduced from this time last year; they could not carry out the working of the company without it, and if they were valued, they would be found to be worth considerably more than they were set down at. The £72,000, due on the 31st December last, was amounts due from the various Government offices, railway companies, the press, and other sources, and, after the 31st December, these amounts kept tumbling in, and were most probably, by this time, all in the hands of their bankers. As to the United Kingdom and the Magnetic Companies, their plan was to charge the same rates as those companies, and, if possible, to beat them out of the field, by doing the work better than them.

Mr. EVANS considered that the directors had the confidence of the shareholders, and that it was not for the benefit of the company that every question should be answered; it might, however, perhaps not be objected to his asking whether the auditors' attention had been called to this item of the stores, as to their actual value, for, in regard to railway stores, an amount was often put down in the accounts, of a most serious description, and taken for granted, without any enquiry or trouble being taken to ascertain their real value.

Mr. ROLLS (auditor) stated that he had made every enquiry as to the value of the stores, and was sure that they were honestly worth the amount charged against them.

The motion that the report be received and adopted, was then put from the chair, and carried.

The CHAIRMAN said that he had to propose that a dividend of £3 10s. per cent., for the half-year, be paid out of the net profits of the company, which, having been seconded by M. Huish, Esq., was carried unanimously.

The CHAIRMAN then proposed that a retiring pension of £300 per year be granted to Mr. Fourdrinier, their late secretary, in consideration of the long and faithful services rendered by him to the company during the last fifteen years, which having been seconded,

Mr. REID said that he was sorry their chairman should be the first to propose to make their company a pension society. What had Mr. Fourdrinier done to call for such a sum being granted to him for life? He would tell them something about him in connection with Nutt & Gamble's patent, which was for an instrument to send telegraphic messages, and connected with it was Colonel Wylde, Fourdrinier, and Gamble the younger. The Electric Telegraph Company opposed it, and after a good deal of money spent in law, and hearing before the Lord Chancellor, a compromise is entered into; Colonel Wylde is made director of the company, Mr. Gamble is made private secretary to the chairman of this company, Fourdrinier is to be provided for, and poor Nott, the inventor, is left to starve. Through the active agency of Mr. Gamble, he gets Fourdrinier appointed secretary to this company by displacing a man who held the appointment, and who was vastly his superior in everything relative to telegraphy and mental qualifications. This was Fourdrinier's entrance into this company; some of the shareholders—if not all—will say, not a very respectable entrance. However, he is possessed of two qualities that deserve to be noticed. The first is his excessive severity to all poor instrument clerks, by enforcing fines of the most aggravating character for the merest trifles. The second quality is his excessive toadyism to the directors; and if a new dictionary is constructed, the word "fawningism" will be properly personified in the character of the ex-secretary. It was understood that Mr. Gamble put him into the place to keep it warm for himself, but, alas! Mr. Gamble, in some unfortunate moment, said that the directors were no better than a set of old women, and for that irreverent expression got discharged, and Fourdrinier still kept his position. He has now for a long term of years been receiving from this company the fabulous sum of £750 per annum; and now, when his term has at last finished, our good-natured chairman has not the moral courage to say, "Mr. Fourdrinier, this company does not require your services any longer; we require a more active, intelligent, and efficient man to fill the office of secretary." In place of taking this honest and straightforward course he, along with some other of the directors, have recommended that he be placed on the pension list, taxing the future resources of this company to the tune of £300 a-year, equal to £1 per day for every working day of his natural life, which may be twenty years—equal to a tax of £6,000 or £7,000. He would only add that, if out of this £750 per annum he could not provide for himself and family—if he has any—he ought to have done so; according to an ancient writer, "He that provideth not for his own household, has denied the faith, and is worse than an infidel." He would now, with their permission, read an extract from the *Times* of this month as a contrast to the excessive liberality of our directors towards the ex-secretary.

The case is a painful one, but will show the way in which our business is conducted. Mr. Reid then quoted from the report of a trial of one of the late *employés* of the company receiving 16s. per week—a starvation point of wages, less than a labourer who carries the hod—and requested the meeting to look at the two pictures, Mr. Fourdrinier and this young man. Mr. Reid then proceeded to say that any stockbroker's clerk would have done all Mr. Fourdrinier's work for £100 a-year, and have done it a deal better.

Mr. Long would ask a question as to the legality of giving this pension. He would warn the directors against getting the company into a mess. Not that it would be worth his while to challenge their proceedings, but any one might file a bill in Chancery against the directors on the point. Other companies certainly had done the same kind of thing, but he did not see the wisdom of doing it in that company, or the authority for doing it. The directors had power to pay for any services rendered, but they had not the power to give away money for services not rendered. It was a precedent which was illegal, and without express authority they could not do it. Granting of pensions is not within the ordinary business of the directors, and well deserves the attention of the board, and it was not fair to be done without some explanatory remarks. Many other shareholders like himself would like to know the nature of the extraordinary services which have been rendered, for if £750 per annum was the value of the services given, why should £300 per annum be given now that those services were not rendered?

Mr. Fraser had great reluctance in doing anything which might appear hostile to the board of directors, but he thought that the meeting were called upon to acknowledge a vicious principle, for every man with such a salary as £750 ought to make provision for himself and family; and the same principle, if applied in this case, may be applied to every other servant in the company's service. He believed that Mr. Fourdrinier had no particular merit in his mode of discharging the duties of secretary more than any ordinary secretary, and it would be too bad to tax the shareholders for this. He would support any other proposition rather than a tax for services not rendered.

A Sharehlder thought that Mr. Fourdrinier had not done anything to entitle him to £300 per annum. He thought it a very awkward proposition, and if that continental war came upon them, of which the Chairman had spoken, that £300 per annum might be found a very serious matter. He must, therefore, oppose it, for every other clerk of the Company might expect the same thing if this were agreed to.

Mr. Reid then proposed an amendment to the effect, that taking into consideration the large sum Mr. Fourdrinier has been receiving for several years from this Company, it is the opinion of this meeting that he has no further claim upon its funds, which, having been seconded, the Chairman remarked that he felt disappointed at the way in which the proposition had been received, as he expected the Proprietors would have been unanimous on the subject. Mr. Fourdrinier's connection with the Company ceased merely from a re-arrangement of the offices, and not from ill health, and a saving would be effected by the alteration. Under the circumstances, he thought that very few of the Proprietors would have felt any difficulty in granting the pension. He thought that perhaps the most convenient way would be to take a vote for the current year, and then have a special meeting to consider the subject.

Mr. Bidder hoped that the Shareholders would not be led away by Mr. Reid, who was guided by a little personal feeling. (Mr. Reid: I have no personal feeling in the matter.) He would suggest that they pass this vote for the current year, and take the Shareholders' opinion as to the future. He believed that the Shareholders would conform to the policy of the Directors.

Mr. Evans remarked, that from the explanations given by the Chairman, the matter came before the meeting in a different shape; it appeared that from the re-arrangement of offices, Mr. Fourdrinier's services were not required, and he thought that the Shareholders would not be wanting in consideration of that matter.

Other amendments having been proposed, Mr. Frazer said, that has they had funds in hand, had they not better vote that a sum of money be given to Mr. Fourdrinier at once, they should then have done with it, and there would be an end of the matter.

The Chairman, in answer to a question, said that they had done away with their metropolitan surveyor, and had engaged Mr. Weaver, at a salary of 1,000*l*. per annum.

Mr. Long wished to know whether the re-arrangement of the officers had saved more than 300*l*. a-year, to which the Chairman replied that the amount payable would be about the same.

Mr. Frazer said that he objected to the principle of this pension, for if they agreed to it they did not know what might come upon them; he would therefore move, "That in lieu of the proposed pension of 300*l*. per annum to Mr. Fourdrinier, the sum of 1,000*l*. be voted to him."

Mr. Evans seconded the proposition, which having been put to the meeting, was carried.

The Chairman then moved the re-election of the following retiring Directors:—Lord Alfred Paget, M.P.; W. H. Smith, Esq., jun.; Lieutenant-General Wylde, C.B.; and Mark Huish, Esq., which was carried unanimously.

The Chairman then proposed the re-election of James Rolls, Esq., as Auditor, which having been agreed to, the Chairman announced the termination of the business of the meeting.

A vote of thanks to the Chairman and Directors, for the manner in which they had conducted the business of the Company during the past half-year, having been cordially agreed to, the meeting separated.

CORRESPONDENCE.

THE PNEUMATIC APPARATUS.

To the Editor of the Telegraphic Journal.

Sir,—The letters signed by Mr. France and Mr. Harwood, contain no positive evidence whatever, but are a loose bundle of deductions and inferences, that hardly merit a reply. Mr. Harwood says he supposed this invention to be Mr. France's, because "shortly after Mr. Andrews ceased to be engineer to the Submarine Telegraph Company I was appointed superintendent of the Cromer station, whence the longest cables leave the English coast, and it fell to my lot to have to remove from some of the most important lines, and replace with the pneumatic relay, instruments which Mr. Andrews had invented, or which, at least, I know *him to have had constructed subsequent to the invention of the pneumatic instrument.*" Your readers will be surprised to learn that one of these pneumatic relays was actually fitted up, and at work, months before Mr. Harwood was appointed at Cromer; preceding his predecessor, Mr. Fernhaber, and during the superintendentship there of a very efficient servant of the Submarine company, Mr. Shaw, who was still in charge at Cromer when I resigned the Submarine service.

On the 9th of September last, Mr. Courtenay, the late esteemed Secretary to the Submarine Company, who well knew this to be my invention, at my request telegraphed to Cromer, as I wanted a spare model for the Persian Gulf, "Have you any of Andrews' pneumatic relays at work on the cables, and have you any spare ones?" The reply was, and the message now lies before me:—"25 service; 2.32 p.m.; 9th Sept., 1863. Cromer to Courtenay, London; Yes. One on each line, but no spare one.—Harwood." I make no comment, except that this discussion at the above date had not arisen, and that Mr. Harwood's views have changed somewhat, between the 9th of September, 1863, and the 30th of January, 1864.

Now this apparatus, and the modifications made by Reid, of those already proved on the line, were coming forward about the same time. No. 3, as Mr. France calls it, was a very perfect instrument. Mr. France himself telegraphed me of this:—"Your apparatus works perfectly; nothing could go better." I dare say I shall find this message. Mr. Shaw, the then Superintendent at Cromer, reported the same of it, and I have now a letter from him to that effect lying before me. There was no necessity, therefore, to press forward the pumps. I think that I am correct in asserting that no other apparatus were ordered by me subsequently to the pump being proved on the line where No. 3, as a distinct instrument, separate from any Morse arrangement, had been a considerable time working. I take it, if an engineer wanted engines to work his railway, and certain descriptions had been proved effective, he would not refrain from ordering more engines required for the service, with modifications, because he had an invention, of which he thought highly, coming forward.

Mr. France appears to have but a very poor opinion of an inventor who invents No. 1, No. 2, and No. 3, and, according to this gentleman's ideas, every invention should be a sort of miraculous conception; instantaneously conceived, as instantaneously applied, and as instantaneously discovered to work perfectly, and to remain a perfect instrument for evermore. *Eureka.*

How many inventors will be of opinion that, had Mr. France possessed any experience whatever in inventions, his views might, possibly, have been more modest.

As to the question of the date of the accounts, Mr. France should be aware that those who make the preliminary apparatus charge on the finally completed apparatus as delivered; dates, in these cases, are no guide to the commencement or germ of an invention.

Respecting Mr. France's statement that, if he is not mistaken, Mr. Banks used to use his name in speaking of the pump relay, Mr. France appears to forget that trials at the office, and experiments on the Belgian wires, with his instrument were made by me for a considerable period. I always spoke, during these experiments, of this apparatus as mine, and certainly Mr. Banks, during this time, always spoke of it and treated it as mine. Mr. Banks, however, must answer for himself.

The fact is, Mr. France has neither disproved my facts, supported by positive evidence, nor has he brought forward any facts on his own side. If Mr. France, therefore, desires me to pay any further attention to his letters, they must not consist too exclusively of that description of reasoning immortalised by Mr. Cuttle.—I am, Sir, your obedient servant,

Melbourne Cottage, North Brixton, Feb. 11, 1864. W. Andrews.

To the Editor of the Telegraphic Journal.

Sir,—In reply to Mr. France's letter about Mr. Andrews' pneumatic relay, I must beg to observe that, even if I were as ignorant of mechanics as Mr. France is pleased to say, still that does not prove him to be the inventor of the arrangement, and the date of the bills would not prove when the work was put in hand, because all first experimental work—sometimes

extending over long periods—is always put in the gross charge of the complete instrument when delivered; and as to my handing Mr. France over to the workmen, it was simply for convenience, and that only about the pump keys, for, as it so happens—*unfortunately* for Mr. France—the *first relays, with Mr. Andrews' arrangement, were not made at the factory at all*, but by a workman employed by us off the premises, who did the work at his own house. All the instructions, with the drawings and alterations made from time to time by Mr. Andrews, were done in my presence, and given to me by him, and such instructions I gave direct to the man, whom I can confidently assert *Mr. France never saw upon the subject.* The workmen he saw at Aldersgate-street were only employed making the keys, and those alone, as I above state; so that Mr. France has cut up his own case in endeavouring to show "that, as Mr. Banks knew all about it," it is not likely he (Mr. France) namely would have been employed to see the workmen direct. He never did see them about the relays; not that I consider this important, as Mr. Banks was continually seeing the workmen during the progress of the work, and yet he does not claim to be the inventor.

After Mr. Andrews had resigned from the Submarine Company, and Mr. France had more instruments made, they were all made on the same model; but Mr. France never claimed them as his.

I am, Sir, your obedient servant,
G. W. GUY.

Windsor-terrace, City-road, Feb. 10, 1864.

[*Erratum.*—In Mr. Guy's letter, which appeared in No. 4, page 44, instead of "making pneumatic arrangement; *also* for the key," read "making pneumatic arrangements for the key."]

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I never used Mr. France's name in connection with the pneumatic arrangement, as Mr. France states I did.

I am, Sir, your obedient servant, J. BANKS.

St. John's Wood, Feb. 12, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I was surprised upon looking over your first number to find the pneumatic arrangement for multiplying the effects of return current accredited to the invention of Mr. Andrews, as the system had been attributed to Mr. France from the day of its introduction, and was generally referred to in connection with his name. When the "Pump Relay" first made its appearance, it was certainly most carefully nursed by Mr. France, and I am confident Mr. Banks has upon more than one occasion given him credit for the idea. Will you kindly insert this in your next number?

I am, Sir, your obedient servant,
J. BOURDEAUX,
Dover, Feb. 9, 1864. Superintendent of the Dover Station.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In reference to the question of the invention of the pneumatic apparatus, I beg that you will allow me to confirm Mr. France's statement, that Mr. Banks, in order to distinguish this instrument from any other of the kind, habitually gave it the name of its inventor, and alluded to it as "France's pump relay." There can be no possible misunderstanding as to the truth of this, and I can further state, that in the course of the many conversations between Mr. Banks and myself, on this subject, I never heard him ascribe its invention to any other person. I can also testify that Mr. France was in this Company's service when this instrument was introduced, and took the earnest interest in its performance natural to its inventor. Having read the directly opposite statements contained in Mr. Banks' letter, I am of course quite prepared to see my assertions denied. The matter can then only became a question of our relative credibility, and in that stage I shall be content to leave it.

I am, Sir, your obedient servant,
Submarine Telegraph Company, JAMES STEPHENSON,
58, Threadneedle St., E.C., Feb. 9, 1864. Assistant Superintendent.

[We think that this discussion should terminate here. Our readers will, no doubt, agree with us that its prolongation would only create unnecessary ill-feeling.—ED. T. J.]

CARTHAGENA AND ORAN SUBMARINE CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—As the information contained in our letter of the 5th inst. may convey some false impression in the minds of your readers, we beg herewith to hand the following, since received from Mr. C. W. Siemens.

"The cable parted at a splice made at our manufactory during the shipment, and the hemp at this particular place on investigation was found discoloured and damaged by some chemical agency, as acid, which by some unhappy accident must have had access to the place while making the joint. In all other parts of the cable the hemp is as good and unchanged condition as ever."

We are, &c.,
Per SIEMENS, HALSKE, & Co.,
3, Great George St., Westminster, S.W., Lloeffer.
10th February, 1864.

TELEGRAPHIC NEWS.

THE ORAN AND CARTHAGENA CABLE.—By the Bombay mail, which arrived at Southampton on the 11th inst., intelligence has been received that the French steamers *Eclaireur* and *Dix Decembre*, from Oran, arrived at Carthagena on the 29th, having succeeded in laying down, for the second time, a submarine cable which is to connect both parts. [We hope the information will prove correct.—ED. T. J.]

THE TELEGRAPH CLERKS' PROVIDENT FUND.—We are glad to hear that the London General Omnibus Company have contributed £2 2s. to the Telegraph Clerks' Provident Fund.

THE TRANSMISSION OF THE QUEEN'S SPEECH.—We were in error when we stated that the Submarine Telegraph Company employed six wires on the occasion—the number was five. We are assured that along two of the wires messages were transmitted at the rate of 25 words per minute; and when we consider that the wires were either buried in earth or submerged in water, which subjected the current to the retarding influence of induction, the transmission was exceedingly rapid. The message was also transmitted to Cologne along two wires at the then rate of 11 words per minute.

TRAIN SIGNALLING.—It had been arranged that, on the 10th instant, their H.R. the Prince and Princess of Wales, the infant Prince, and their suite were to travel along the South-Eastern Railway. We understand that among the precautions adopted to ensure safety the Electric Telgeraph stood prominent. Under the superintendence of C. V. Walker, F.R.S., and his staff, who were accompanying the Royal train, a complete set of instruments were provided for communicating along the train, and by means of which, in case of accident, information could be sent to any station on the line. A handsomely bound message book was also provided for their Royal Highnesses' use during their stay at Hastings.

OVERLAND TELEGRAPH.—Below we give a highly interesting and important letter from the President of the California State Telegraph Company to J. J. Southgate, Esq., containing proposals from the company for the establishment of telegraphic communication between Victoria and San Francisco. The distance from Fort Vancouver, to which point the company expect to have the line completed in a few weeks, to Olympia, with which port there is regular weekly steam communication, is just 120 miles, making a total of less than 250 miles which would then have to be constructed to complete the connexion. The portion between Olympia and Victoria might very easily be laid as a submarine line, at probably less cost than by the rugged an unsettled land route, and the whole sum required from Victoria to finish the line between that place and Portland or Fort Vancouver would be trifling compared even with the amount of interest proposed to be paid to the projectors of the route between the Canadas and that colony. The commercial advantages to Victoria of the Californian route would be quite as great as those offered by the other. The only difference is in case of a war with the United States, in which case, of course, the line would be useless:—"Californian State Telegraph Company, San Francisco, November 17, 1863. Dear Sir,—This company proposes next year to extend its lines of telegraph to Victoria, if any encouragement shall be afforded that will justify it in doing so. The incomplete line from Yreka in California, through the State of Oregon, to Fort Vancouver, in Washington territory, which has been for two or three years in process of construction, has just passed under the control of this company, and will be completed within a few weeks. Thence to Victoria a line would be very expensive, and could not be remunerative for many years to come. If, therefore, this company undertakes to build the line, it will ask some assistance from the people of Vancouver's Island and British Columbia, by way of cash subscriptions, to be refunded in telegraphing or in the full paid stock of this company, which pays regular and certain dividends. But the principal aid or encouragement to be sought for at that end of the line will be a grant from the Government of such privileges as will secure the line for a reasonable number of years against competition in the business between Victoria and San Francisco—contingent, of course, upon the line being completed within a certain period, to be clearly specified. No subsidies will be asked for from the Government, nor any franchises that can in any way interfere with the proposed line across the continent through British territory. I need not say anything to you of the very great importance to the people of your province of a speedy telegraphic connexion with the balance of the world. I presume that you are fully alive to its importance, and it appears to me that the result will be accomplished a year or two the sooner by a little well-directed assistance to the enterprise now proposed. This company owns all the telegraphic lines and franchises in the states and territories west of the Rocky Mountains, and I presume there can be no doubt as to its ability or intentions. I shall be greatly obliged to you if you will have the kindness to make inquiries in the proper quarters and communicate with me as to the prospects.—Very respectfully yours, H. W. CARPENTER, Pres. Cal. State Tel. Co.—J. J. Southgate, Esq."

THE OTRANTE AND AVELONA SUBMARINE CABLE.—In another part of the Journal a notice will be found of the safe arrival of the ship *Semaphore*, with the above cable on board, at Malta. We have been informed that the vessel has now reached its destination, and that the shore ends have been laid, and intelligence of the submersion of the whole cable is hourly expected.

The Electric and International Dramatic and Discussion Club.—The first meeting of the Discussion Class, in connexion with the above club, took place, as per announcement, February 10th; Mr. F. Perry presiding. After a few introductory remarks from the chairman, Mr. Young proceeded to deliver his essay upon "Women, morally, socially, and intellectually considered." In the discussion which ensued, Mr. Brandon fully agreed with Mr. Young that the present unsuitable employments for the female sex were at variance with their interests, and tended greatly to impair their future usefulness in life as wives and mothers. Mr. Garrard then continued that, though he fully endorsed the sentiments of the last speaker, he thought that women ought to have more congenial occupations open to them, and strongly deprecated the employment of men in drapers' shops. The discussion was considerably enlivened by the jocose and humourous remarks of Mr. Plainway, and the proceedings terminated with a cordial vote of thanks to the secretary for his very able essay.

Denmark, Sweden, and Norway.—The Submarine Telegraph Company give notice that during the interruption of communication by the *direct route* to the countries in consequence of the war in Schleswig-Holstein they have increased their charges.

The Persian Gulf Cable.—Letters have been received from Sir Charles Bright and staff, dated Bombay, the 13th January, stating that the *Kirkham*, with the mid-ocean portion of the cable on board, had arrived safe at that port, and that the expedition for laying down the cable was to start the next day, commencing with the section from Gwadel. All reported well, and the weather favourable.

The Pacific Telegraph.—Telegraphic facilities are rapidly increasing along the Pacific slope. A line is now being constructed from San Francisco to Portland, Oregon. Workmen are at work in extending the wires from Sacramento, along the line of the Pacific railroad, across the Sierra Nevada, making it, when completed, the third line belonging to this company crossing these mountains. Men are also at work in the Carson Valley, extending the line westward from this end to meet it.

The Cape.—The *Argus*, of the 19th of December, states that the electric telegraph is now in operation as far as Mossel Bay from Cape Town, and would be completed to Graham Town by the end of the year. The Cape of Good Hope Telegraph Company was to complete the line from Cape Town to Graham Town very shortly after the departure of the last mail for Europe, and it was to be available for the use of the public on the 15th of January. Cape Town was already in communication with George Town, and Graham Town with Uitenhage. The only link which is wanted to complete the communication throughout being in the Langeklof. The distance between the termini is over 600 miles, along which the whole of the poles have been fixed. All that which was required now was a short length of wire. The company had not published its scale of charges, but it was known that the same had been subjected to and approved of by the Government. The cost of transmitting a message of twenty words from Cape Town to Graham Town was to be 12s. 6d., and from Cape Town to Fort Elizabeth 10s. For the same number of words the charges from Cape Town would be as follows:—To Caledon, 2s. 6d.; Swellendam, 3s.; Riversdale, 4s.; Mossel Bay, 5s.; George, 5s. 6d.; and Uitenhage, 8s. Messages would also be forwarded by post, and special messengers to King William Town, according to arrangement, and hence by telegraph to East London. The charges between intermediate stations would be on the same scale as those already mentioned. Although the charges may appear as rather high, the question of the distance and the comparatively small number of messages which would be transmitted would not admit of any material reduction.

The Correspondent of the *Times* furnishes the following information from Malta on the 6th instant:—The *Cossack*, 20, screw frigate, Capt. W. R. Rolland, left at noon on Monday for Bengazi, with Mr. Saunders, electrician to Messrs. Glass, Elliot, & Co., to test the Malta and Alexandria cable, after landing her passenger on Wednesday sailed on return to Malta, arriving here on Saturday morning. M. de Sauty, electrician to the same firm, has passed through Malta to Alexandria to test the Alexandria end. He is expected back to-night, to await the arrival here of the cable ship, which is on her way from England, when he will proceed in her, with an efficient staff of engineers and workmen, to repair the fault. From the testing already made at Bengazi it has been pretty surely ascertained that no electrical defect exists, and that the interruption is owing to some mechanical accident, which is believed to have happened nearer to Bengazi that at first supposed. It was most probably caused by a ship's anchor. Wind and weather permitting, no difficulty is anticipated in a speedy and complete repair being effected. While on the subject of telegraphs I must mention that the electric cable which arrived here last week in the English screw steamer *Semaphore* is for the Italian Government, to replace that laid by Messrs. Newall & Co., between Otranto and Avlona, on the Albanian coast, and which has defied all attempts to repair it. The new cable was made at the works of Mr. Henley, the manufacturer of the Persian Gulf cable. This short line will prove of great service in completing the communication with Greece and different parts of the Levant. There is a rumour that the Italian Government intends shortly to lay a cable between Marsala and Tunis, to be constructed also by Mr. Henley, which will place Malta in almost direct telegraphic communication with that regency and the province of Algeria. The Mediterraenan Extension Telegraph Company have announced that the line between the Dardanelles and Scio is interrupted, and that messages must consequently be sent by post to Gallipoli.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine mixed, first and second qualities .	2/3 to 2/6 per lb.
Good re-boiled	1/7 to 1/10 "

India Rubber.

Para, first quality	1/10 to 1/11 "
second "	1/7 to 1/8 "
third Negro-head	1/2 to 1/3 "
Java and Penang	1/4 to 1/6 "

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	107 to 110	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	¼ to ½	—
5	United Kingdom Telegraph .	3	½d to par	—
10	Mediterranean Extension Tel. .	all	3½ to 4½	—
5	London District Telegraph Co..	all	1¼ to 1¾	—

TO CORRESPONDENTS.

P. L. D. and others.—The reports of telegraph companies' meetings, which occupy a considerable portion of our present number, compel us to defer the publication of your interesting contribution until next week.

J. Allen.—We shall certainly be happy to illustrate with engravings instruments of practical utility.

Parliamentarian informs us that Mr. H. Moor, one of the candidates for the representation of Brighton, is chairman of the Mediterranean Telegraph Company. We hope that several gentlemen connected with telegraphy will be found in the next Parliament.

Holyhead.—"F." will be attended to.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
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Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)............	0	3	0

Single Advertisements from the country must be accompanied with stamps in payment.

THE TELEGRAPHIC JOURNAL.

VOL. I. No. 8.—FEBRUARY 20, 1864.

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THE HALF-YEARLY REPORTS OF TELEGRAPH COMPANIES.

THE Reports which have appeared in our columns of the operations for the last half-year of several Telegraph Companies are upon the whole of the most encouraging character, and will have been read with satisfaction by the commercial and scientific friends of one of the greatest achievements of modern times.

The Electric and International Telegraph Company's report shows a steady improvement in the Company's revenue, the last half-year's receipts exceeding that of the preceding half-year by £20,076, the total receipts being £137,150. It appears that the extension of the Company's line to the south of Ireland has been a very profitable one, owing to the great number of American messages received; and we may reasonably infer from the fact that when the Atlantic Cable is laid, the above line will be one of the most important and, no doubt, remunerative in the kingdom. The Company also are reaping the advantages which necessarily must accrue from the extension of the telegraphic system throughout Europe.

The total expenditure for working charges and interest on debentures for the half-year amounted to £86,582, leaving a surplus of net profit on the six months of £50,568, which enabled the Company to declare a dividend at the rate of 7 per cent. per annum, leaving after such payment the large sum of £16,447 to be placed to the credit of the trust fund for the purpose of replacing and repairing submarine cables. It is admitted that this balance is larger than that carried forward on previous occasions, and that the Company's submarine lines are now all in excellent working order. The electrician, Mr. Cromwell F. Varley, also reports all the land circuits in excellent working order, and that during the late severe storms the system remained unimpaired. Several valuable improvements had been introduced in the mode of insulation, which had considerably expedited the rate of transmission, and a system of establishing direct communication between the most important stations had been adopted, which would avoid, to a considerable extent, clerical errors and delays, and save much manual transmission. The following table shows the half-year's increase in the extent of the Companies' lines:—

	Dec. 1863.	June, 1863.	Increase.
Miles of line	8,230	8,006	224
Miles of wire	39,042	36,391	2,121
No. of instruments	4,489	4,163	326

The Mediterranean Extension Telegraph Company has, after a series of vicissitudes, been enabled to report to its proprietary that their prospects were rapidly improving; the balance-sheet for the past half-year showing the Company to be in a better position than it has been since its commencement; and had it not been for the unfortunate interruption in the working of the Malta and Alexandria Cable, it was believed that the receipts would have been nearly doubled as compared with the previous year. It is a source of great satisfaction to understand that the Company's cables continued in excellent working order, and that the accident which since the publication of the report has occurred to one of the Company's cables, will be speedily repaired. The Directors were enabled to recommend a dividend of 8 per cent. per annum on the preference shares, and 4 per cent. per annum on the original shares, also adding 10 per cent. on the gross earnings to the reserved fund. The prosperous condition of this Company, its increasing traffic, and the satisfactory state of its important lines, must greatly tend to the development of ocean telegraphy as a remunerative commercial undertaking.

The Directors of the Telegraph to India Company intimate to the shareholders that the remaining assets had been disposed of, and that there were no further liabilities. The Company is in receipt of £2,500 per annum from their Alexandria, Cairo, and Suez line, leased to Messrs. Glass, Elliot and Co. at the above yearly rental. In the case of this Company, as in that of the Mediterranean Extension Telegraph Company, the interruption on the Malta and Alexandria cable has not been without its effect. In glancing over the receipts, we find that the 200 miles of cable intended for replacing the defective portions of that of the Red Sea Company, and which cost some £20,000, has been disposed of for £8,000—rather a small sum, taking into consideration the price of gutta percha at the date of its manufacture and its present market value. We have, however, been assured that the cable is in an excellent state of preservation.

The British and Irish Magnetic Telegraph Company report favourably of its operations during the past year, showing a continued increase of revenue. The expenditure, owing to increased business and cost of maintaining the lines, had been larger, great improvements having been effected during the year in several of the principal districts. The Company's submarine lines between England and Ireland were partially interrupted, and it was determined to have the cables thoroughly and efficiently repaired, which has now been effected, involving an expenditure of £5,000. The Directors, however, despite the heavy outlay, have recommended a dividend at the rate of 4½ per cent. per annum for the first half, and 5 per cent. for the second half-year, thus making 4¾ per cent. for the year against 4½ per cent. for 1862. The extension of the Company's lines—and more especially that between Cork and Cape Clear, with the view of intercepting the steamers from America—has fully justified the expenditure. The total income for the year is put down as £108,267 18s. 7d., and the working expenditure as £69,649 14s. 8d.

The London District Telegraph Company still continues to progress steadily. It appears that, notwithstanding the heavy expenditure incurred in the course of the past half-year in consequence of the severe gales towards its close, the receipts for the same period show an increase of £109 17s. 1d., and £327 0s. 10d. over those of the corresponding period of 1862. The Company have now upwards of fifty contracts for the maintenance of private lines, and have entered into arrangement with the Metropolitan Railway Company for the exclusive commercial and general telegraph business on that line. The system of telegraphs for the use of the Fire Brigade has also been completed, and works satisfactorily.

During the half-year new offices have been opened in Ratcliff and London Wall, and the cost of all these works has been added to the capital account, and are all represented as remunerative. Total amount received for messages, rent of private wires, &c., £4,326 4s.

Thus, having rapidly glanced over the reports hitherto published, we have no reason to complain of the present, or to doubt the future of Electro-Telegraphy.

SUBMARINE TELEGRAPHY.

We have on more than one occasion directed the attention of our readers to the importance of submarine telegraphy as the only means of uniting England with America—"a consummation devoutly to be wished." Since the failure of the Atlantic cable in 1858, the public have looked askance at all submarine projects, and "knowing ones" have shrugged their shoulders as if dubious of the practicability of ocean telegraphy. The improvements which have been effected in the manufacture of deep-sea cables, the ingenious and efficient machinery of late employed in paying them out from vessels into the ocean, coupled with the successful submergence in Europe of no fewer than fifty-two lines of telegraph, encourages the hope that future attempts to unite the old with the new world will be attended with success. We append a table, showing the number of lines laid to the present date, and, with one or two exceptions, they are in efficient working order:—

Submarine Telegraph Cables which are now in Successful Working Order.

No.	Date when laid.	From	To	Number of Conductors.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.
1	1851	Dover	Calais	4	27	108	—
2	1853	Denmark . . across	the Belt	3	18	54	—
3	1853	Dover	Ostend	6	80½	483	—
4	1853	Frith of Forth	— —	4	6	24	—
5	1853	Portpatrick	Donaghadee	6	25	150	—
6	1853	Across River Tay	— —	4	2	8	—
7	1854	Portpatrick	Whitehead	6	27	162	—
8	1854	Sweden	Denmark	3	12	36	14
9	1854	Italy	Corsica	6	110	660	325
10	1854	Corsica	Sardinia	6	10	60	20
11	1855	Egypt	— —	4	10	40	—
12	1855	Italy	Sicily	3	5	15	27
13	1856	Newfoundland	Cape Breton	1	85	85	360
14	1856	Prince Edward's Island	New Brunswick	1	12	12	14
15	1856	Straight of Canso	Cape Breton, N.S.	3	1½	4½	—
16	1857	Norway . . across	Fiords	1	49	49	300
17	1857	Across mouths of	Danube	1	3	3	—
18	1857	Ceylon	Mainland of India	1	30	30	—
19	1858	Italy	Sicily	1	8	8	60
20	1858	England	Holland	4	140	560	30
21	1858	Ditto	Hanover	2	280	560	30
22	1858	Norway . . across	Fiords	1	16	16	300
23	1858	South Australia	King's Island	1	140	140	45
24	1858	Ceylon	India	1	30	30	45
25	1859	Alexandria	— —	4	2	8	—
26	1859	England	Denmark	3	368	1104	30
27	1859	Sweden	Gottland	1	64	64	80
28	1859	Folkestone	Boulogne	6	24	144	32
29	1859	Across rivers	in India	1	10	10	—
30	1859	Malta	Sicily	1	60	60	79
31	1859	England	Isle of Man	1	36	36	30
32	1859	Suez	Jubal Island	1	220	220	—
33	1859	Jersey	Pirou in France	1	21	21	15
34	1859	Tasmania	Bass Straits	1	240	240	—
35	1860	*France	Algiers	1	520	520	1585
36	1860	Corfu	Otranto	1	90	90	1000
37	1860	Denmark	Great Belt {14 miles / 14 miles}	6 / 3	28	126	18
38	1860	Dacca	Pegu	1	116	116	—
39	1860	Barcelona	Mahon	1	180	180	1400
40	1860	Minorca	Majorca	2	35	70	250
41	1860	Iviza	Majorca	2	74	148	500
42	1860	St. Antonio	Iviza	2	76	152	450
43	1861	Norway . . across	Fiords	1	16	16	300
44	1861	Toulon	Corsica	1	195	195	1550
45	1861	Holyhead	Howth, Ireland	1	64	64	—
46	1861	†Malta	Alexandria	1	1535	1535	420
47	1861	Newhaven	Dieppe	4	80	320	—
48	1862	Pembroke, Wales	Wexford, Ireland	4	63	252	58
49	1862	Frith of Forth	— —	4	6	24	—
50	1862	England	Holland	4	130	520	30
51	1862	Across River Tay	— —	4	2	8	—
52	1863	Sardinia	Sicily	1	243	243	1200
			Totals		5625	9783½	

* The cable between Algiers and France has been injured (supposed to be by lightning).
† Injured by a ship's anchor, but now being repaired.

Thus it will be seen that there is in Europe an aggregate of 5,625 statute miles of submarine telegraph actually in operation, laid in lengths of from 4½ to 1,535 miles, in depths ranging from 15 to 1,580 fathoms. Since 1854, 95 lines, in lengths of from 120 feet to 23 miles, have been laid in the American rivers, and are found to work well, particulars of which we append:—

Submarine Telegraph Cables in Operation in the United States, Canada, and the Lower British Provinces.

No.	Date when laid.	From	To	Number of Conductors.	Length of Cable in Statute Miles and Feet. m.	ft.	Length of Insulated Wire in Statute Miles and Feet. m.	ft.
1	1854	Perth Amboy, N.J.	South Amboy, N.J.	3	1		3	
2	1854	Arichat, N.S.	Across Lennox Passage	2	1		2	
3	1854	Harlem, N.Y.	do. Harlem River	3		225		675
4	1854	Norwalk, Ct.	do. Norwalk River	3		175		525
5	1854	Westport, Ct.	Saugatuck River	3		300		900
6	1854	Bridgeport, Ct.	Across Pequannock Riv.	3		125		375
7	1854	Naugatuck, Ct.	do. Conn. River	2		300		600
8	1854	do. do.	do. do.	1		300		300
9	1855	Plaister Cove, N.S.	Port Mulgrave	3	1½		4½	
10	1856	Rouse's Point, N.Y.	Across Lake Champlain	1		450		450
11	1856	Canals, Draw Bridges	&c. &c. &c.	3 to 6	1	720	5¾	
12	1856	Ogdensburgh, N.Y.	Prescott, C.E.	3	1	120	3	360
13	1856	Five miles above	Sorel, C.E.	1	1	260	1	260
14	1856	Sorel, C.E.	do.	1		350		350
15	1857	Bush & Gunpowder, Pa.	Draw Bridge	3		300		900
16	1857	do. do.	do.	3		300		900
17	1857	Lambertville, N.J.	New Hope, Pa.	3		400		1200
18	1857	Morrisville, Pa.	Trenton, N.J.	3		300		900
19	1857	Trenton, N.J.	Morrisville, Penn.	3		300		900
20	1857	do. do.	do. do.	3		300		900
21	1857	New Brunswick, N.J.	Canal Crossing	3		300		900
22	1857	do. do.	do.	3		300		900
23	1857	Newark, N.J.	Draw Bridge	3		300		900
24	1857	do. do.	do.	3		300		900
25	1857	do. do.	do.	3		300		900
26	1857	do. do.	do.	3		300		900
27	1857	Hackensack, N.J.	do.	3		300		900
28	1857	do. do.	do.	3		300		900
29	1857	do. do.	do.	3		300		900
30	1857	do. do.	do.	3		300		900
31	1857	do. do.	do.	3		300		900
32	1857	Havre de Grace, Md.	Perryville, Md.	3	¾		2¼	
33	1857	Perryville, Md.	Havre de Grace, Md.	3	¾		2¼	
34	1857	South Amboy, N.J.	Across Raritan River	3	¾		2¼	
35	1857	New York	Hoboken, N.J.	3	¾		2¼	
36	1857	do.	do. do.	3	¾		2½	
37	1857	India Point Bridge, Mas.	Providence, R.I.	3		125		375
38	1857	Parkersville, Va.	Across Ohio River	3		1670	1	
39	1857	Boute D'Lisle, C.E.	12 miles below Montreal	3		1500	¾	460
40	1857	do. do.	do. do.	3		850	½	
41	1857	Quebec, C.E.	Caronge, C.E.	3		3400	2	
42	1857	Newark, N.J.	Draw Bridge	3		300		900
43	1858	Arichat, N.S.	Across Pugwash Harbor	3	1½		4½	
44	1858	Highlands, N.Y.	Shrewsbury River	3	¼		¾	
45	1858	Boston, Mass.	East Cambridge, Mass.	1		125		375
46	1858	Parkersburgh, Va.	Ohio River	3		2400	1	1920
47	1858	Black Rock, N.Y.	Crossing River	3		2800	1	2120
48	1859	Camden, N.J.	Philadelphia, Pa.	3	1		3	
49	1859	St. Louis, Mo.	Cairo, Ill.	3		2500	1	2 20
50	1859	Meredosia, Ill.	Across Illinois River	3	¼		¾	
51	1859	Benicia, Cal.	Martinez, Cal.	1	1		1	
52	1859	Hell Gate, N.Y.	Across East River, N.Y.	3		2000	1	720
53	1859	Guilford, Ct.	do. Conn. River	1		100		100
54	1859	New London, Ct.	do. do.	1		1900		1900
55	1859	do. do	do. do.	1		1200		1200
56	1859	Terre Haute, Ind.	Across Wabash Riv., Ind.	2		250		500
57	1859	do. do.	do. do.	2		250		500
58	1859	St. Louis, Mo.	Across Mississippi River	2		3000	1	720
59	1859	do. do.	do. do.	2		3000	1	720
60	1859	do. do.	do. do.	2		3000	1	720
61	1860	New York	Hoboken, N.J.	3	¾		1¼	
62	1860	Through Victoria	Bridge, Montreal	3	2		6	
63	1860	do. do.	do. do.	3	2		6	
64	1860	Quincy, Ill.	Across Mississippi River	1	1		1	
65	1860	Greenport, L.I.	Sag Harbour, L.I.	1	1½		1½	
66	1860	New York, N.Y.	Hoboken, N.J.	3	¾		2¼	
67	1860	do. do.	do. do.	3	¾		2¼	
68	1860	do. do.	do. do.	3	¾		2¼	
69	1860	Sarnia, C.W.	Port Huron, Mich.	3		1500		4500
70	1860	Niantic River, Ct.	Across Niantic River	1		125		125
71	1860	do. do.	do. Conn. River	1		300		300
72	1860	Warren, Mass.	do. Fall River, Mass.	1		1500		1500
73	1861	Perryville, Md.	Havre de Grace, Md.	1	¾		¾	

No.	Date when laid.	FROM	TO	Number of Conductors.	Length of Cable in Statute Miles and Feet. m.	ft.	Length of Insulated Wire in Statute Miles and Feet. m.	ft.
74	1861	Philadelphia, Pa. . .	Camden, N. J.	3	1		3	
75	1862	Troy, N.Y.	Across Hudson River .	7		300		2100
76	1862	Henderson, Ky. . . .	do. Ohio River . .	1	½		½	
77	1862	Paducah, Ky.	Illinois Shore, Ohio River	1		3000		3000
78	1862	do. do.	Across Tennessee River	1		1000		1000
79	1862	St. Louis, Mo.	do. Mississippi River	2		3000		6000
80	1862	Henderson, Ky. . . .	do. Ohio River . .	1		3000		3000
81	1862	Louisville, Ky. . . .	do. do. . .	3		1800	1	120
82	1862	Cincinnati, Ohio . . .	do. do. . .	1		1500		1500
83	1862	Point Pleasant, Va. . .	do. do. . .	1		1800		1800
84	1862	St. Louis, Mo. . . .	do. Mississippi River	1		3000		3000
85	1862	Fortress Monroe . . .	Cherrystone	1	23		23	
86	1862	do. do. . . .	Newport News	1	3		3	
87	1863	St. Charles, Mo. . . .	St. Louis, Mo.	1	½		½	
88	1863	Albany, N. Y. . . .	Hudson River	3		1900		3600
89	1863	Cairo, Ill.	Kentucky Shore, Ohio riv.	1		3500		3500
90	1863	New Brighton, S.I., N.Y.	Across the Kills, N.Y. .	3		3000	1	3720
91	1863	Tottenville, N. Y. . .	do. Bay of New York	3		2000	1	120
92	1863	Troy, N. Y.	do. Hudson River .	3		230		690
93	1863	Benwood, Va. . . .	Bellaire, Ohio	1		1500		1500
94	1863	St. Louis, Mo. . . .	Across Mississippi River	1	½		½	
95	1863	Alburg, Vt.	Swanton, Vt.	1		130		130

The fact of so many cables having been successfully laid, demonstrates the practicability of submarine telegraphy, and we hope that this method of communication will prove more felicitous in the future than it has been in the past. An attempt is being made by the Atlantic Telegraph Company to raise a new capital, in order to carry out the scheme which proved so disastrous to all concerned in 1858. We wish them every success, and trust that next year they will be enabled to submerge a cable in the bed of the Atlantic, and, by facilitating correspondence with the new world, realise a handsome return for the capital invested in the undertaking.

REPORT OF THE BRITISH AND IRISH MAGNETIC TELEGRAPH COMPANY (LIMITED).

The directors beg leave to submit to the proprietors the accounts for the past year, which show a continued increase in the revenue of the company. The expenditure is larger, partly the natural result of an increased business, but mainly owing to the additional cost of maintaining the lines, great improvements having been effected during the year in several of the principal districts.

In the course of the past summer first one, and shortly after, the other of the Irish cables, both of which had previously been in good working order, gave way, and it became necessary to repair them without delay. The directors foresaw from the first that the cost would be very considerable, and the unavoidable expense was increased by the unusually stormy and unfavourable weather in August and September.

The communication with Ireland, although much curtailed, was never interrupted, and the repairs of both cables were effected in a satisfactory manner, leaving reason to hope that no further outlay will be required for some time. Bearing in mind, however, the age of the cables, and the uncertainty attending all such means of communication, the directors have determined to charge the whole of this expense, amounting to nearly £5,000, to the past year. The amount available for dividend has thus been reduced much below the actual amount of the net earnings of the year; but the directors have, nevertheless, been able to declare dividends at the rate of 4½ per cent. per annum for the first half, and 5 per cent. for the second half year, thus making 4¾ per cent. for the year, against 4½ per cent. for 1862. After doing so, they are still able to make a small addition to the reserve fund. They think that this statement will prove satisfactory to the proprietors, and that the course adopted of meeting a heavy extraordinary expense out of the year's revenue will commend itself to their approval.

Several additions have been made to the company's lines in the past year; the principal has been from Cork to Cape Clear, with the view of intercepting the steamers from America at the earliest possible moment. The service is one of difficulty and great uncertainty from various causes, but the directors do not regret the extension.

Considerable further progress has been made in the substitution of overground wires for the remaining underground sections of the lines, and the anticipated improvement in the working has thereby been realized.

J. C. EWART, Chairman.
E. B. BRIGHT, Secretary.

Liverpool, February 12th, 1864.

REPORT OF THE LONDON DISTRICT TELEGRAPH COMPANY (LIMITED).

The net receipts for the half-year ending 31st December, 1863, show an increase of £109 17s. 1d. over the previous half-year, and £327 0s. 10d. over those for the corresponding period in 1862.

The directors are glad to inform the shareholders that an agreement has been entered into with the Metropolitan Railway Company, granting to this company the exclusive commercial and general telegraph business on that line, and offices will shortly be opened at all of their stations.

During the half-year offices have been opened in Ratcliff and London-wall, and some additional agreements entered into for private telegraphs. The London Fire Brigade Telegraph has also been completed, and is reported upon satisfactorily. The cost of all these works has been added to the capital account, and they are all remunerative.

The directors regret that the charges for maintenance and repairs are unusually heavy; partly to be accounted for by the expenses consequent on the severe gales towards the close of the half-year; partly by the greater portion of the instruments and batteries at most of the stations having been repaired or renewed; and partly by a new cable having been required under a portion of the London Docks.

The directors have been enabled to provide for these expenses, both on the capital and maintenance accounts, and have not, therefore, thought it advisable to make further issue of either the original or forfeited shares at present, or to exercise the borrowing powers conferred by the articles of association. When additional capital is required it may be obtained from any of these sources.

It should be borne in mind that the second half of the year is always the less remunerative, owing to the vacation months intervening, and generally the most expensive in point of maintenance of lines, &c.

Pursuant to the articles of association, two directors, C. K. Dyer, Esq., and S. Gurney, Esq., M.P., retire from the board, but being eligible offer themselves for re-election.

The auditors likewise retire. Mr. Sandell offers himself for re-election, but, since the notice of meeting, Mr. M. Chubb has resigned. It will, therefore, be the duty of the shareholders to elect his successor.

The directors have further to state that, in consequence of Mr. Chubb's sudden resignation, the present accounts are signed by only one auditor.

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(Continued from page 78.)

6. *Insulators for Land and Aerial Lines.*

No change of importance has occurred in the construction of land lines since 1851. Iron wire of about No. 8, B.W.G. (⅙ inch diameter) is still generally adopted for the conductor in England; larger gauges, such as No. 4, or even No. 1, are adopted for direct transmission over long circuits). In France, wire of 4 millimètres diameter (=0·16 inch nearly) is used.

Earthenware, stoneware, and glass insulators are now considered inferior to those made of poreclain. Stoneware is generally porous; glass is found to break easily, and to condense surface moisture to a great extent. Porcelain insulators are imported in large numbers from the Continent, and some apparently good specimens are shown by J. B. Cappellemans, Sen. H. M., Brussels (Belgium, 860), and by H. Schomburg, Berlin (Prussia, 2177).

S. W. Silver & Co., M. (United Kingdom, 2960), exhibit insulators made entirely of hardened india-rubber or ebonite, a material which has been used to a considerable extent in coating the iron pins of porcelain and other insulators. From tests made by Messrs. Silver, it would appear that the hygrometric qualities of ebonite are extremely good, and no serious deterioration of the

material has been observed during an experience of about two years.

Mr. Meyer (Hamburg, 130) also exhibits good ebonite insulators.

C. F. Varley, M. (United Kingdom, 2981), exhibits insulators intended for use where very good insulation is required, as in lines of 200 miles and upwards. They consist of an upright iron bolt or pin, the head of which is covered with ebonite, or vulcanite, as it is sometimes called, on which rests a porcelain inverted cup. This cup is again covered by a second cup of porcelain, on the top of which the wire to be insulated rests. By this arrangement, one, or even two, of the three insulating covers may be cracked or porous, or otherwise defective, without sensibly injuring the insulation of the line. Mr. Varley's insulators are also made with a special quality of stoneware made by compression from a peculiar clay. This stoneware is at least equal to porcelain.

Mr. Varley showed the Jury a record of experiments in which the deflection indicating a loss during heavy rain from lines insulated in this manner was not more than 5 divisions, when the deflection from a wire of equal length, fixed on similar insulators, without vulcanite on the pins, was 90 divisions, and from a wire supported by single inverts, 370 divisions. During a fog the relative losses were 23, 55, and 405 respectively; these numbers were examples taken at hazard from a great number of experiments.

Mr. Varley considers that the insulation resistence of a line in the worst weather, expressed in Mr. Varley's units, should not fall below the quotient of 40,000 by the length in miles. Mr. Varley's unit is equal to 26·6 of Siemens' units.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2864), exhibit two forms of insulator designed by Sir Charles Bright.

1. A porcelain invert with vertical sides and a small spread of surface, cemented over a straight iron bolt and nut; soft india-rubber is placed round the bolt inside the cement, to prevent the expansion of rust from cracking the porcelain cup. This plan of using india-rubber is said not to be of much use, but the insulator affords good insulation at a low price.

2. A double bell, with a shackle bolt, intended for use where great strain comes on the wire. The double bell is held in a wrought-iron fork, by a bolt passing through the axis of the two bells, and two eyes of the fork. The other end of this fork forms a hinged shackle. The wire is attached between the two bells; it ends at each post, and is connected across to the next section by a short wire outside the insulators. This form is specially suitable to terminal poles and over-house work, where great spans are combined with sharp curves or angles; the hinge of the shackle allows each insulator fork to take the line of the wire attached to it. These insulators are extensively employed for over-house work in London, Dublin, Glasgow, &c.

Siemens, Halske, & Co., M. (United Kingdom, 2959), exhibit two forms of insulator, which they call respectively the strainer and intermediate insulator. They use the strainer to secure the wire at about every 500 yards with six or eight "intermediate insulators," supporting the wire by hooks, in which it can slip when a change of weather expands or contracts the wire.

The strainer is composed of the following parts:—An inverted porcelain cup is firmly cemented in a cast-iron bell, provided with a vertical flange bracket. By means of this flange the insulator is fastened to the post with wood screws. A wrought-iron stalk is cemented inside the porcelain cup; this stalk is enlarged at the end, where two notches or recesses are formed of such shape as to allow the wire to be secured by wedges or cottars. The wire between the notches is bent into a circular loop to allow the wire to be slackened in cold weather, or when repairs require it.

The intermediate insulator is of similar construction, but the stalk ends in a hook, in which the line wire rests free to move to and fro. The cast-iron bell protects the porcelain cup from injury, and also from wet, improving the insulation. These insulators are strong but heavy, and are not so cheap as some of the forms usually adopted. The intermediate insulators are quoted at 1s. 3d. complete, and the straining insulator at 3s. 3d. They are extremely well adapted for use in countries where repairs are difficult, and supervision imperfect, owing to their strength and good fastenings.

Reid Brothers (United Kingdom, 2949) exhibit several insulators. 1. A large glass invert with stout glass stem, used in South America. The glass stem is simply dropped into a hole bored in a wooden cross-bar. 2. A double bell insulator, supported by an iron bracket from beneath, with a vertical iron bolt through the centre of the two bells; the glass or porcelain part of this insulator is similar to that exhibited by the British and Irish Magnetic Company, and already described. It can be removed and replaced without withdrawing any bolts or nails from the wooden post. 3. A cap insulator used between Birmingham and London. This insulator, made entirely of stoneware, without any iron fastening, is slipped over the top of the post, which it protects against wet. It is a cheap form. 4. An insulator intended for lines to be erected in haste without poles. The upright pin of a common invert is bolted to the butt end of a strong horizontal wrought-iron spike. This spike can be driven into trees, walls, houses, &c., and the insulators fixed with great rapidity. A large number of them have been supplied to the army.

The Danish State Telegraph (Denmark, 123) exhibits some good and strong insulators used in Denmark.

7. *Posts for Aerial Lines.*

The old wooden post is still generally used to support the insulators and wires, but a large number of wrought-iron posts have been used with advantage in India and other countries, where wood is subject to rapid decay. The District Telegraph Company also supports its wires used in over-house work by cylindrical telescopic wrought-iron poles, stepped on to the ridge tiles of house-roofs and stayed with iron wire ropes.

Siemens, Halske, & Co., M. (United Kingdom, 2959), exhibit wrought-iron telegraph posts, which they expect will last so much longer than wooden posts, as possibly in many countries to be the cheaper form in the end, although entailing greater expenditure at first. Each post consists of three square wrought-iron rods (three quarters of an inch square for intermediate, and one inch square for terminal posts), firmly secured at their upper end by a wrought-iron ring and wedges to a wooden top similar to the top of a common post, and at their lower ends fixed to three cast-iron plates buried in the earth. They are further strengthened by two or more wrought-iron stays fixed between the rods at different heights, and wedged to them by means of wrought-iron collars. The insulators are fastened to the wooden top. The various parts of these posts are easily transported, and need only be put together on the spot where they are intended to be erected. They offer a small surface to the wind, and stand firmly on a strong base. They are well adapted for countries where the means of repair are not at all times near at hand, and the communication slow and scarce. The smaller post weighs 2 cwt.

W. T. Henley, H. M. (United Kingdom, 2908), also exhibits wrought-iron posts designed with the same view. They are formed of four thin plates of iron, each so bent that its cross section forms a quadrant with radial external flanges at each end. Four of these plates bolted together from the post, and the flanges running from top to bottom, stiffen the structure. Mr. Henley uses either a wooden or a wrought-iron top and a large flat cast-iron base.

8. *Novel Construction of Aerial Lines in Large Towns.*

The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2978), has been formed with the view of providing independent or private wires for the use of large firms, and others having establishments in different parts of the same town. A large number of conductors are required to carry out this idea, and the method by which they have been provided is cheap, novel, and entirely successful; the system was devised by Professor Wheatstone, and may be described as follows:—

Straining posts are fixed on the tops of public buildings or private houses at distances of about a mile, and their positions are so arranged that when joined by straight lines a series of nearly equilateral triangles is mapped out. From each of these straining posts, in six different directions nearly equidistant from each other, pairs of steel or galvanized iron wires or ropes are stretched to the six adjacent strainers distant about one mile. Intermediate supporting posts without insulators are fixed at convenient distances. A rope consisting of a bundle of about fifty copper wires, each separately covered with india-rubber (exhibited by Messrs. Silver), is suspended from each pair of iron wires by loops at short intervals along their entire length. The ropes terminate at the straining posts, and the free ends of all the wires are brought into a box. By means of suitable connections in this box the wires arriving from one direction can be joined to those proceeding in any other, and thus the wires may be combined in every desirable manner, and the combinations changed as required. From these boxes the single wires also proceed, which complete the commu

nication between the main lines and the establishments to be placed in connection with them.

The triangulations above described are of course only extended to those parts of a town where a large number of conductors are required, and may be intermitted where other means of carrying the rope are more convenient or economical.

9. *Land Lines Underground.*

Underground wires are now used as little as possible, owing to the decay of both gutta-percha and india-rubber under these circumstances.

C. V. Walker, H. M. (United Kingdom, 2983), shows a very simple form of trough in which underground wires, where unavoidable, are protected against the effects of the atmosphere or against mechanical injury.

A V groove is cut from a rectangular piece of wood by two saw cuts; the piece cut out is turned over so as to form a cover, which is lashed down by wires at short intervals. The insulated wires lie in the covered trough bedded in sand and tar. The adjacent lengths of wood are spliced together by a V of thin hoop iron, driven half into one and half into the other.

INSTRUMENTS EMPLOYED IN THE TRANSMISSION OF MESSAGES.

1. *Codes used or proposed, in which the Letters of the Alphabet are represented by new Arbitrary Symbols.*

The transmission of messages is still in a great measure effected by arbitrary signals, depending for their signification on the order in which various series or groups of currents succeed each other. Each letter of the usual alphabet is represented by a distinct group of currents, or of the signs which they are made mechanically to show or record, and much ingenuity has been exercised in devising codes which should use the fewest currents in the representation of words as written at full length in the usual alphabet.

The elements from which alone codes of this nature can be formed are the following:—

1. The presence of a positive current.
2. The presence of a negative current.
3. The change from one current to the other.
4. The absence of both currents.

5 and 6. The duration of the positive and negative currents respectively.

7. The duration of the absence of all current.
8. The strength of the current.

These elements clearly could not all be combined in any one code.

The Morse code is framed on the combination of a long and short current of the same kind, separated by intervals of three different lengths; the shortest used between each current, the next between each group representing a letter, and the longest between each series of letters representing a word. Reverse currents are now frequently used to produce these intervals on the recording instruments, but the code was framed without reference to their use. The long and short currents are generally called dashes and dots, from the marks which they produce on the paper band of the original Morse receiver.

A code, which may be called the Steinheil code, is framed on the combination of short, positive, and negative currents of equal length, with intervals of three different lengths, as in the Morse code. In other words, the alphabet when written is formed of groups of positive and negative dots.

Both of these codes can be read by the eye with moving needles, or by the ear with bells, as well as written on paper. The Steinheil is the shorter code of the two. In both care is taken that the letters most frequently used shall be expressed by the shortest groups of signals.

A Morse code common to all usual languages is now almost universally adopted, and the Steinheil alphabet can readily be made to correspond to it by letting, say, a positive current stand for a dot, and a negative for a dash.

Wherever, as in short land lines, currents can be made to succeed each other with indefinite rapidity, the number of currents used in a code is of less importance than the simplicity of the apparatus required for their transmission and reception; but where the number of currents that can be transmitted distinctly in a given time is limited, the number used for a word becomes a matter of commercial importance. Mr. Whitehouse and Professor W. Thomson both proposed codes for use on the Atlantic cable, which were more advantageous than the Morse or Steinheil codes.

T. Allan, M. (United Kingdom, 2850), exhibits a code which appears to the writer to be, as compared with the number of reversals required, the shortest yet published. In this code, as written, every letter is composed of a group of perfectly similar dots separated by three sets of intervals, as in the other codes: but Mr. Allan's apparatus is so arranged as to print a dot at each change of current, whether from positive to negative, or from negative to positive; while the maintenance of either current, or the complete interruption of all current, indifferently produces the intervals. Thus Mr. Allan uses what we have called the third and seventh elements; whereas the Morse code uses the fifth and seventh elements, and the Steinhill code the first, second, and seventh elements.

Mr. Whitehouse used the third, fifth, and sixth elements. In the usual Morse alphabet, if reverse currents are used, two reversals are necessary for each dot or dash; but in Mr. Whitehouse's alphabet, modified by Professor Thomson, each reversal produces a dot, which corresponds to the maintenance of either current. So far Mr. Whitehouse's and Mr. Allan's codes are on a par. Mr. Whitehouse, however, in order to denote any interval longer than the shortest used between the dots, was obliged to reverse his current, and maintain it for a longer time than that used for the dot; the longer intervals between words or letters were thus marked by lines. Mr. Allan, on the contrary, simply maintains his last current or interruption, and needs no fresh reversal to express the pause or interval, whatever its length, and gains in this respect an advantage over all other codes known to the writer. Mr. Allan's code is evidently the offspring of his automatic system presently to be described, but it might be used quite independently of that system.

The Morse, Steinheil, and similar codes are equally adapted for transmission directly by hand, or indirectly by mechanism, and by voltaic, induced, or magnetic-electric currents. The instruments used in connection with these codes, as distinguished from those used in step-by-step dial and printing telegraphs, will be first described, beginning with the instruments used by hand for direct transmission.

(*To be continued.*)

LONDON DISTRICT TELEGRAPH COMPANY (LIMITED).

THE tenth half-yearly ordinary general meeting of this company was held on Thursday last, at the offices of the company, 90, Cannon-street, London, Robert Taylor, Esq., Chairman of the Board of Directors, presiding; a large number of shareholders being present.

The SECRETARY having read the advertisement calling the meeting, the report was agreed to be taken as read.

The CHAIRMAN then said, that it would be seen from the statement of accounts presented to them, that the receipts of the company had not arrived at that state to which it was hoped at their last meeting they would have attained, but it was satisfactory to know that they were improving, as their balance sheet would show. When first he joined that company, he did so because he believed that it would be an useful and profitable company, and that it would be eagerly sought after. In New York the telegraphic companies paid something like 10 per cent., and he thought certainly that in London, the ready aid which its operations would afford to the inhabitants, would have been so appreciated that its financial affairs would have been placed in a more prosperous condition; but though that had not been the case at present, yet he hoped that the time would arrive when the company would right itself, and be as it ought to be. The Metropolitan Railway Company had entered into an arrangement with them, by which they had the entire right over their lines, and he believed that it would turn out to be very profitable. The Magnetic Company have in the past behaved in the most kind and liberal manner towards that company, and they have continued the same aid to the present time. He wished he could say the same of the Electric and International, for had they behaved in the same way as the Magnetic, their affairs would have presented a different appearance. He would now call their attention to a fact which, as shareholders, they should all be made acquainted with, namely, that their receipts throughout the month of January had increased £20 per week, and if they should succeed in going on at the same rate during the next half-year, when they again met, they might expect to see themselves so much improved in their finances as to be able to meet all their expenses, and after being able to do that, they would require very little more to enable them to pay a dividend. That was the state of affairs during the past half-year, and he had now only to move the adoption of the report, and the statement of accounts.

Mr. SHEWARD seconded the motion.

Mr. Hardy Wells said that he could not help thinking that the report now presented was of a very discouraging character, and gave very little hope for the future. Three half-years back their balance at the bankers was £947, the following half-year it was only £742, and this half-year it was but £438, which he considered to be very unsatisfactory. Under such circumstances, therefore, he thought it was necessary that the shareholders should ask the directors to put the domestic economy principle into practice, and cut down all expenses within their power. It would be seen that £3,000 had been paid to the directors alone for the management of the company. Now, that did appear to him to be too much for so small a company, and he would request the shareholders to ask the directors, in common language, only to pay themselves according to the means of the company. The company was but small, and he knew that the directors had its welfare as much at heart as the shareholders had; and he considered that the best thing they could do was to ask them to reduce their numbers. They had now seven directors, and if three of them would consent to take the place of the seven whilst the company was in its present low state, he thought that they would soon be much better off. He believed that very much of the success of the company was owing to their excellent secretary, Mr. Curtoys, and he thought that, with his able assistance, they might do for the present with three directors, and thus effect a saving. He should like, also, that they would have but one auditor, instead of two, and thus reduce their expenses, especially as it would be seen that one had audited the present accounts. They saw that all the directors were not necessary, for one of them (Sir C. Bright) was some thousands of miles away, and was likely to be so for some months to come.

Mr. Mitchell did not rise to grumble, but to express his gratification at the way in which the directors had managed the affairs of the company, and in bringing them so far within the prospect of having a dividend. He was, however, inclined to the idea that one auditor might be sufficient, as their object just now was economy, and that would produce a small reduction in the expenses. There were two items put down in the accounts—salaries, £456; wages, £2,167—why could not both these be charged under one head, as he considered salaries to be wages? There was a suggestion he would also wish to offer to the directors; it was, that he did not think that they made themselves sufficiently known to the public—they did not advertise as they ought to do. If they would erect a kind of box in some of the leading thoroughfares, as they did in Paris, and advertise their stations and terms, they would find it greatly increase their business, and it might be done at a very little expense; but he would leave that for the consideration of the board. He could not sit down without expressing his gratification at the prospects of the probable ultimate success of the company.

The Chairman, in reply to Mr. Mitchell, said that the Metropolitan Board of Works would not allow such erections in the public streets as those he had just mentioned. With regard to the items salaries and wages, they were put down in that manner so that the shareholders might ask any questions in relation to them which they might think fit; the salaries being for secretary, &c., and the wages the payments to the various clerks, &c. He might inform them that it was a source of continual pain to the directors that they found themselves unable to pay those young ladies in the manner they ought to be paid. Holding positions of responsibility, as those young persons did, the directors felt that it was not doing justice to them, and their wonder was how they were enabled to make both ends meet; as it was, he regretted to say that they were frequently losing them, from the fact of their going to other companies, where they received better pay.

Mr. Cable.—By the articles of association the accounts should be audited by two auditors. On the present occasion it appeared that they were only audited by one. He wished to know whether the directors were satisfied with that? By the report he found that Mr. Chubb had sent in his resignation as auditor. He was not quite satisfied with this statement. He should therefore like to know whether Mr. Chubb had sent in a resignation or not, as he had heard some rumours about him which were not very creditable?

The Chairman said that the directors were as much taken by surprise as Mr. Cable, for they had sent out their notices, according to the articles of association, when they received a notice from Mr. Chubb, from Paris, resigning his appointment. Mr. Sandell thereupon undertook to audit the accounts by himself, and, from his well-known position in London, the directors believe that his audit will be taken as satisfactory.

Mr. S. S. Taylor said that in the report there was an item of expenditure of £479 for works; but, seeing the difficulties of the company at the present time, he thought that they ought not to be laying out money from the capital account until they had received something for what they had already invested. Their money had now been lying for five years, and they had received no dividend. He considered that £20,000 out of their £50,000 had gone in waste. He really did think that, under the circumstances, every attention ought to be paid to economy. He was not at all disappointed with regard to the company, for he thought that when they got their revenue to £10,000 they should be doing well. They had got to nearly £9,000 now, and he thought that they ought to be able to make some profit out of that. They must, therefore, keep down the expenses, and then they would very shortly produce a dividend. He would suggest whether the charges for supervision could not be kept down? As to wages, they all knew how difficult it was to keep pace with them. He wished to ask a question with regard to the rental. They were going to receive a larger amount in the way of rental. This, however, did not appear much greater than last half-year. Stationery was put down at £236. That seemed a large amount: a great quantity of stationery ought to be obtained for that sum. He merely threw out these as hints. Then there was travelling expenses, £48. He did not quite understand that. All those items ran up, and it would be as well to look at them and see whether they could not be reduced. He also considered that 15 guineas was too much to be paid to each auditor. He thought that, under the present circumstances of the company, the directors should forego for a little time their remuneration, and so bring its affairs into a paying condition. If he were a director of a company like that, he should be very sorry to take anything out of it for his services.

The Chairman, in reply, said that Mr. Taylor had brought several things before them. He could assure them that the directors had nothing to keep back from the shareholders; they were anxious to furnish them with the fullest information on any subject connected with the company—no question would be considered too searching; for his own part he could never connect himself with any company where there was anything to be kept back from the shareholders. With regard to the wages, he could inform them that the directors took it in turn to go through them every week, and it only grieved them that they were compelled to pay their staff so badly. With respect to the rent, they had hoped to have been able to have brought that down lower; they had now let the house to a great advantage, and they had got the tenant of that portion of it to allow them the use of that room for their meeting, so saving them two or three guineas for the hire of a room at the London Tavern. As to the stationery account, that must, of necessity, be a large item in a company like that; they were served by contract, and from what he knew, by his connection with other companies, he must say that they were supplied at a much less rate than was usual. Travelling expenses, &c., £48, had been mentioned; this arose from repairs of lines, collection of accounts, &c., but he might inform them that there was not a sixpence put down in the accounts but what went under the searching eye of one of the directors, who attended to those matters especially. With regard to the expenditure on the capital account, the directors were very anxious to obtain the London Fire Brigade traffic under Captain Shaw, seeing that it would be an element of great profit to the company ultimately, and they succeeded in their attempt; for this, however, they had to construct lines, which have been charged to the capital account, but from which they expect to reap a remunerative profit, and if they had not done it, another company would. As to the remuneration of the directors, he could assure them that they did not hold their office merely from motives of profit; they did not desire to remain in office, and, if the shareholders thought that they could get any body of men to serve them better, they were quite willing to resign their positions. He would repeat, that it was only because he thought he saw in the company elements of usefulness that he connected himself with it; he was, however, bound to say that at present it had not realised his expectations, although he believed that it would ultimately. "'Tis not in mortals to command success, but we 'll do more, for we 'll deserve it." There might not be blue sky now, but they should see it by-and-bye.

The motion for the adoption of the report was then put, and carried unanimously.

The Chairman then proposed that C. K. Dyer, Esq., and S. Gurney, Esq., M.P., be re-elected as directors of the company, which having been seconded,

Mr. Cable said that he must congratulate the shareholders that Mr. Taylor had succeeded to the chairmanship of their company. Mr. Gurney was well known in the City of London, but he was hardly ever present at the meetings of the board, and, as the question arose whether the number of the directors should not be reduced, and by the articles of association he found they could be reduced to five, he would recommend that the present vacancies should not be filled up. Mr. Taylor spent a vast amount of valuable time for the interests of the company, and was always at his post, and deserved their best thanks.

Mr. Austin believed that Mr. Gurney would prefer not being re-elected. It would be no very great object for him to be a director, especially as his time was so taken up with other duties; but he (Mr. Austin) felt that the company gained a great deal of influence in other directions through his having a seat at the board. Now their success depended greatly on their relation with other companies, and he believed that they should not have survived if they had not kept on good terms with them. Mr. Dyer is a director of the Magnetic Company, and Mr. Gurney is a director of the Submarine, and by their influence the company was benefited, for they received a commission for all the messages which they delivered to or for them, and the Magnetic had assisted them very materially.

Mr. Wells had no personal feeling towards the directors; he only wished to put the matter before them, as to taking remuneration for their services until their revenue and expenses balanced. He believed that the company would yet become a great success; there were all the elements of success in it, and it only required time to develop it. He was well aware that the directors did not hold their office for the amount of money they received, and he believed that it would give greater confidence if it went forth to the world that they received no remuneration for their services.

Mr. Tromp knew, from inspection of the wires through London, that they were in an excellent state, and he believed that the directors had done everything in their power to keep them so.

A SHAREHOLDER wished to know whether there would be any alteration in the mode of transmission and delivery of messages in the future, for he had found much difficulty from the inaccuracy with which the message was taken and the slowness in delivery.

Mr. SHEWARD had taken a very great deal of interest in the company, and wished to see it work well, and, for the purpose of testing it, he had gone to different stations where he was not known and sent messages, in order that he might ascertain correctly how it worked, and he had found it to work well. He thought that it was a very unfair thing for the gentleman who had just spoken to come into that room and charge the directors with mismanagement, without having first spoken to the manager about what he had to complain of, in order that it might be looked into. They were in the habit of sending about 1,000 messages per day, and in not more than one per cent. of them was there a mistake. In testing the rapidity with which the messages were delivered, he found them to be delivered in a much shorter time than he expected. The first part of the morning and the afternoon were the busiest parts of the day, a much greater number of messages being sent then than in the middle of the day; and if these messages were to be sent more rapidly, they must keep a much larger staff of boys than they now did, or have a different kind of messenger, for they all knew what boys were when they went on an errand, if they only came across Punch and Judy. The cost of maintenance had greatly increased during the past half-year, but that had arisen from circumstances over which the directors had no control, the gales which had occurred having caused damage to their wires. The balance at the bankers was less than it formerly was, being a natural consequence of the expense they had been put to. The best friend to the management of the society was he who came to the office and pointed out the errors that occurred, so that they might be rectified.

A SHAREHOLDER must bear his testimony to the rapidity and general accuracy with which the messages were delivered, and the attention always paid to any instructions which might be given.

The CHAIRMAN considered that it was not right for such charges to be brought forward at the meeting as had just been made; they had a most excellent and obliging Manager and Secretary, of whom, on account of his being present, he could not say all that he might say, or ought to say, and if these complaints had only have been made to him as they ought to have been, he would not have rested until he had found out the cause, either of the error or delay. So far as he (the Chairman) was concerned, if he had not wished to have brought the ship safely into deep water, he should have given up long ago, and it was neither kind nor generous towards the directors to bring forward such charges on this occasion, especially when by calling at the office at the time, they would have been remedied. He could only say, that anything which the directors could do for the welfare of the company without starving it, would be done. He had always found it very false economy to starve the staff required to carry out the objects of a company. The observations made by Mr. Wells and others, would receive the most serious consideration of the directors when they next met.

The motion for the re-election of Messrs. Dyer and Gurney, as directors, was then put, and carried unanimously.

Some discussion then ensued as to the election of auditors.

The CHAIRMAN then proposed Mr. Sandell and Mr. Eames to be the auditors for the year ensuing. They all knew Mr. Sandell, from his having filled the office of auditor before; and as Mr. Eames had been in the habit of attending all their meetings, and catechising the directors, the shareholders could not, perhaps, select a better man to watch over their interests.

Mr. TROMP wished to know how much was paid to the auditors? (The CHAIRMAN: Fifteen guineas each.) He hoped the shareholders would ask the directors to pay them ten guineas each, instead of fifteen. If the company was in a better position they would have no objection to pay them.

Mr. EAMES was glad to find that they intended to have two auditors. He would rather have filled the office for nothing than that there should have been but one, for they had just now seen, in their own case, the importance of having two appointed. If he should be chosen as one of the auditors, they should have all the ability which he could bring to bear for the good of the company, as they well knew that he had always done his best for its prosperity.

Mr. WELLS suggested that Mr. Eames accept the office gratuitously.

Mr. AUSTIN thought it was not good policy to get work done for nothing, for where boards did their work for nothing it was generally found to be badly done, whilst it was their wish to have everything done as well as possible.

Mr. SANDELL wished to say a word about remuneration. He gave a deal of time in his earlier days to obtain a perfect knowledge of accounts, which many think to be very easy, and, having done that, he considered that he ought to receive some remuneration for his knowledge. He should be very happy to resign the position which he had held amongst them for the last five years if they wished it, but, if re-elected, he was mercenary enough to say that he should only work for pay.

The motion, having been put from the chair, was carried.

The CHAIRMAN then proposed that the auditors receive the same amount as before for their services, which, after a few remarks, was also carried.

The CHAIRMAN having announced that the business of the meeting had concluded,

A vote of thanks to the chairman and directors for the way in which they had conducted the business of the company during the past half-year was carried unanimously, which

The CHAIRMAN briefly acknowledged, and assured the meeting that they would continue to do all in their power for the advancement of the interests of the company.

LAW INTELLIGENCE.

NEWALL v. ELLIOT.—PATENT CASE.—This was an action for the infringement of the plaintiff's patent for an apparatus for laying down submarine electric cables. Mr. Newall, the plaintiff, Mr. Carpmael, the patent agent, and several other witnesses were examined. The plaintiff was a manufacturer of electric cables, having works at Gateshead and a shop in the Strand, and the defendant carried on the same trade at East Greenwich and Great George-street, Westminster. The alleged invention for which a patent was taken out in 1855 consisted of an apparatus for enabling the cable to be laid down quickly, without handling it in the hold of the vessel, and without the risk of its getting into "kinks" or knots. The rope is coiled in an annular chamber, and the outgoing parts pass inside certain rings. The infringement complained of was committed by the defendant in laying down the cable between Malta and Alexandria some time in 1861. An injunction was granted by Vice-Chancellor Wood to restrain the defendant from using a similar apparatus to that of the plaintiff, but it was dissolved by the Lords Justices, and the plaintiff now sought to establish his right to the invention by the verdict of a jury. Mr. Grove, Q.C., in his opening statement, explained that in the first instance the defendant fitted up his vessel with an apparatus nearly identical with the plaintiff's; but before she sailed from England a portion of it was removed, and the infringement of the patent was not actually consummated until she arrived at Malta. The defendant contended, under these circumstances, that the plaintiff could not sue him for the infringement of the letters patent, inasmuch as it took place beyond British dominion. The learned counsel observed that a patent for an improved compass, a new description of rope, or anything else, intended chiefly for nautical purposes, would be useless to the inventor if any person could infringe it on board a British ship as soon as she got beyond our shores. He submitted that as an English ship was British territory, an user of a patent on board, in whatever part of the world she might be, without the sanction of the patentee, amounted to an infringement.—The Lord Chief Baron: Then the infringement turns upon the nationality of the vessel?—Mr. Grove: To some extent.—The Lord Chief Baron: That is a point which I certainly will not decide here. With regard to what you say as to the user of your patent on board a British ship, it may, on the other side, be urged that your claim would have a tendency to give you a monopoly all over the world. For many purposes a British ship is considered to be part of British soil; but my impression is that this doctrine is part of international and not of municipal law.—Mr. Montagu Chambers said that he should contend that the patent in this case, which was granted for Great Britain, Ireland, the Channel Islands, and the Isle of Man, did not extend to Malta, Alexandria, or Australia, so as to make anything done on board the ship there a violation of such patent. He said it was the custom amongst inventors to take out patents, not only for the British Islands, but also for her Majesty's dominions abroad, and for different foreign countries.—The Lord Chief Baron: Your proposition is that if a man made and sold on board a British ship at Melbourne one of Bramah's locks, which is patented here, he would infringe the patent?—Mr. Chambers: Yes; because it is made and sold out of the limits to which the patent extends.—Mr. Grove: I contend that the making of the lock would, under those circumstances, be an infringement, as it was done on board a British ship. There may be a doubt whether the selling would be an infringement.—The Lord Chief Baron: The Australian colonies have legislatures of their own, and may also have their own patent laws.—Mr. Grove: That may be so, but Malta has no patent laws of its own, and it forms parts of the British territory. In this case the infringement we complain of, though commenced in this country, was really consummated on the high seas between Malta and Alexandria. The learned counsel added that the plaintiff instituted a suit in Chancery in 1857 against the defendant for an injunction, and that the whole matter was then referred to Mr. Thomas Webster, the counsel, for arbitration. That learned gentleman made an award substantiating the plaintiff's claim, but he raised certain points of law for the opinion of the Court of Common Pleas. These points were also decided by that Court in favour of the plaintiff. The depositions of Mr. Laws, who was on board the Malacca, one of the vessels employed in laying the cable, and who was now in India, as to the mode of paying out the cable, were put in and read. Mr. Thomas Webster was then examined with respect to what took place before him as arbitrator. The Lord Chief Baron said he should hold with regard to those acts complained of by the plaintiff as an infringement of the patent which were committed out of British territory, that the fact of their being done on board an English ship was of no consequence. The evidence would be taken subject to that ruling, upon which he would give the plaintiff liberty to move the Court above. Mr. Bramwell, the civil engineer of Great George-street, was next called and examined at considerable length in support of the

plaintiff's case. The case, which occupied the Court during the whole of five days, came to a conclusion on Saturday, the 6th inst. The jury found a verdict for the plaintiff, subject to certain points of law, which were reserved for the opinion of the Court above.

The Submarine Telegraph Company *v.* Dickson and others.—The plaintiffs were the owners of the telegraphic cable lying at the bottom of the sea between Dover and Calais. The defendants were shipowners (aliens), and their ship, *Gustaff Adolphe*, while sailing upon the high seas, more than three miles from the English coast, lowered an anchor, and injured the plaintiffs' cable. From the declaration it appeared that the plaintiffs were possessed of a telegraphic cable, which they used for the purpose of transmitting messages between the ports before-mentioned; that the defendants, not regarding their duty whilst the telegraphic cable of the plaintiffs was lying in the high seas, took so little and such bad care of their ship that a cable and an anchor attached thereto were dragged against and caught hold of the said telegraphic cable of the plaintiffs, and dragged, injured, and broke the same, whereby the plaintiffs have been forced to pay the sum of £2,000 in repairing the damage so occasioned; the plaintiffs also lost and were deprived of their telegraphic cable for the space of eighty-one days, and all the profits and advantages which, during that time, they might have derived and acquired from the use of the said telegraphic cable by the sending of messages and otherwise. The defendants said that the said telegraphic cable alleged to have been injured, was lying at the bottom of the sea, more than three marine miles from the sea shore of England, out of and beyond the realm, dominion, sovereignty, and jurisdiction of our lady the Queen, and the said vessel was then also more than three marine miles from the said sea shore, and out of and beyond the said realm, dominion, sovereignty, and jurisdiction respectively, and the defendants then and at the time of the commencement of this suit, were and still are aliens, subjects of the kingdom of Sweden, domiciled in parts beyond the seas, to wit, at Gothenburg, in the said kingdom of Sweden, and subject to the laws of that country, and not to the laws of England, and that the ship was and still is a Swedish and not a British vessel; and the defendants further say that in the usual and ordinary course of navigation, the said ship was proceeding on a voyage from Alicante to Gothenburg, and that upon such voyage, the said ship had occasion to cast anchor, and afterwards had occasion to get up her anchor and proceed on her voyage, and the defendants say that without any default of theirs, the said anchor, after it had been cast as aforesaid, became entangled with the said telegraphic cable, and that in getting up the anchor, in order to save the same, it became necessary to disentangle it from the telegraphic cable, and that part of the said telegraphic cable was necessarily a little dragged and injured; and the defendants further say, that there was no buoy or mark of any kind to show or point out the spot in which the said telegraphic cable was lying, and that before and when the said telegraphic cable so became entangled it was at the bottom of the sea, and incapable of being seen by, and that the place and position and existence thereof was wholly unknown to the defendants and their servants having the management, direction, and control of the said vessel and anchor. The plaintiffs say that before and at the time when the said ship so dragged her anchor, and when the said telegraphic cable became entangled with the said anchor, the defendants and their servants ought to have known, and had the means of knowing the place, position and existence of the said telegraphic cable, and it was through the carelessness, negligence, and want of ordinary or any care of the defendants that the grievances were committed. The plaintiffs also say that one end of the said telegraphic cable was fastened to the soil of the county of Kent, and by virtue of the license, grant, and charter of our lady the Queen, the cable being so fastened, was carried thence across the sea shore of the said county into the sea abutting thereon, and was within three marine miles of the sea shore and coast of the said county of Kent and of the said county, and the said grievances were committed within such three miles as in the first count alleged, and not more from the sea shore of England. Mr. Rochfort Clarke, for the plaintiffs: The defendants show that they were acting with negligence upon the highway of the sea. Persons using a highway must not use it so negligently as to damage anything. Notice is unnecessary. Even where oyster beds are public nuisances, they must not be negligently disturbed. The questions of knowledge and ignorance are matters which must go, with a hundred others, to the jury. The defendants only say that they had no notice of the cable when they cast the anchor. But they may have carelessly allowed the anchor to drag along the bottom, and then carelessly pulled it up.—Mr. Archibald (Mr. Bovill, Q.C., and Mr. Lush, Q.C., with him) for the defendants: The declaration is bad. It is true that it is in the form adopted in collision cases. But this is a novel case, unknown to the code of navigation. It is, therefore, important that the declaration should disclose a clear and imperative duty. All parties who navigate the sea have a right to anchor where the tide turns. Negligence must arise from the breach of some duty, and, unless some duty be shown, the mere averment of negligence goes for nothing. The law as to collisions is an exception to the general principles. In such cases the duty is notorious, and certain regulations are laid down. With regard to the question of jurisdiction, I admit that if a cause of action arise within a country where the claim could not properly be dealt with, this country will deal with it. But that is not so here.—Chief Justice Erle: I think that the declaration is good. Plaintiffs, who are owners of a telegraphic cable, complain of an accident which befel that cable, owing to the negligence of the defendants. I assume, for the purpose of this judgment, that it is lawful to make use of the bottom of the sea for certain purposes. And I think that this Court may take judicial notice of submarine cables. They are named in Acts of Parliament, and are known throughout the world to be lying at the bottom of the sea. In my opinion, therefore, the plaintiffs had a right to use the bottom of the sea, and to place cables there for the purpose of telegraphic communication. The defendants had a right to traverse the sea for the ordinary purposes of navigation; but they carried their rights to excess, so that they came in conflict with those of the defendant. The plaintiffs' property has been damaged, but the defendants say they are not responsible. They say they had a right to the management of their ship, without the control of the plaintiffs. The plaintiffs may answer, true you had that right, but in exercising it you were not to be allowed to harm my cable in a way the contrary of what skill would dictate and due care require. The whole case dwells in that word—negligence. These courts have, then, jurisdiction over the defendants, who have violated the rights of others. Even if they acted in the lawful enjoyment of a right, they acted with negligence. If they had shown due skill, no mischief would have happened. If one person, knowing that another has claims which conflict with his own, carelessly forgets them, he is almost guilty of wilful injury. The declaration, therefore, is good, and the fifth and ninth pleas good. The discussion which has taken place has been a profitable one, as it will put the real question more distinctly before the jury, than would otherwise have been the case. The word "negligence" has a most undefined meaning, it is often as much misapplied as the term "fraud." It is much better that our decision should not turn upon a misapplied term. As for the argument, that the damage arose from the plaintiffs not having placed a buoy over the cable, and that the defendants, without notice, would not be responsible, it cannot be admitted. If there were no notice, a man navigating with due care and skill would not be liable. But the new assignment in effect traverses the plea, and says that there was no due care. If the defendants had no knowledge, at least, they had the means of knowledge, and if the plea be taken away, the declaration and new assignment, when put together, are good. It was said, that if the vessel had been damaged by the cable the owners might have been sued. I think that precisely the same question would then arise as does here. If it were tried the jury would be told to say, whether or not the plaintiffs had laid down buoys with the usual caution, giving other parties the means of avoiding damage. If, according to the mode in which the ship was sailing, she would, in the ordinary course of things, have surely struck against the cable, the plaintiffs would, undoubtedly, have been guilty of negligence.—Justice Williams: I am of the same opinion. I think the declaration good, because it raises the substantial question in the case. As for the new assignment, I must say that to treat it as my Lord does, is rather opposed to my views of the object of a new assignment. But I am willing to treat it as a traverse of the pleas; it will lead to the trial of those facts upon which the issue of the case depends.—Justice Willes: If what took place is assumed to have taken place on the high seas, the plaintiffs may support this action. I was puzzled to find out what the high seas had to do with the question. A vessel must be managed in such a way as that she shall not, by the negligence of her crew, damage the property of others. The mere novelty of the case is nothing, it is only a novelty of circumstances. A steamer going over the bank of Newfoundland may not see the bank, but will run upon it if she does not observe due precaution. Circumstances like these may be taken into account in ascertaining whether there has been negligence, or reasonable care. If an anchor were lying in the highway, and you knew it were there, you might not injure it. So, if any object be mentioned in the charts of the ports which the ship visits, as lying at the bottom of the sea, and if the ship is provided with those charts, or has the means of procuring them, she must do no harm to that object. Such matters must be taken into account by the jury, and cannot be pleaded, so that a question of this kind becomes an inference of fact, and not one of law. If a vessel were improperly anchored at a great distance from another vessel which was approaching, this last one must avoid the other if she can do it with safety. The utmost vigilance, is not, however, called for, if the obstruction be unexpected.—Judgment: That the Court would presume that the masters of ships were aware of the existence and situation of submarine cables, and that a duty was thereby cast upon all such masters of ships to manage their vessels so carefully and skilfully as to avoid (if possible, in the exercise of reasonable precaution) injuring these cables.

New South Wales.—Mr. Cracknell, the superintendent of telegraphs, brought before the Select Committee of the Legislative Council of New South Wales, appointed on the 8th of July last, the subject of connecting with the electric telegraph lines all the lighthouses of the colonies. He considered that the expense would not exceed £5,500. Mr. Cracknell also called the Committee's attention to the applicability of the electric light for lighthouse purposes, having been successfully employed in England, such as at South Foreland and Dungeness; and to the valuable employment of the electric telegraph for meteorological purposes.

CORRESPONDENCE.

THE PNEUMATIC APPARATUS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I beg of you to insert this, my last letter. In your first number it states the pneumatic apparatus had been for many years exclusively adopted by the Submarine Telegraph Company. Mr. Harwood's letter plainly says some were at work when he took charge, but not on all lines.

With respect to the service message of the 9th September, 1863, he sent the only reply a subordinate could forward to his superior officer—had he entered into a discussion it might not have proved very satisfactory to himself. If Mr. Andrews took advantage of his position to represent to the late secretary that the invention of one of his subordinates was his own, your readers will not fail to see such conduct is of a piece with the "I engaged Mr. France," contained in his letter of the 20th ult.

Since Mr. Shaw is quoted I enclose his letter for insertion, and also my instructions to him, for your perusal, in which you will not find the slightest mention of my own name. I fully agree with Mr. Andrews that Mr. Shaw was a most efficient officer, whose services we were loth to lose.

With regard to any letters or service messages about the three other systems, I admit all Mr. A. likes to bring forward. I have not once presumed to judge their respective merits—he undertook that task himself.

What Mr. Guy terms "unfortunate" I conceive, on the contrary, to be the greatest piece of good fortune possible. He says the first pump-relay was not made at the factory at all. The workman he speaks of is Mr. R. B. Jones, electric telegraph machinist, of Nelson-terrace, City-road. The reason I know his name is, that he called on me, in company with Mr. Guy, at the end of 1860, respecting these very relays. I have written to Mr. Jones, and perhaps he will kindly furnish you with the date of the first instrument, without "beating about the bush," as Mr. Guy does. This would settle, once for all, whether any were made before my return from the Mediterranean in February, 1860.

To finish with Mr. Guy's random statements, I never had occasion to have a single pump-relay made, as Mr. Andrews had ordered a sufficient quantity to replace the whole of his No. 3.

I am, Sir, yours very obediently,
J. R. FRANCE.
February 16, 1864. Acting Engineer, Submarine Telegraph Co.

[COPY.]
Cromer Station, January 27th, 1861.

J. R. France, Esq., Engineer.

Dear Sir,—I have carefully watched the working of your pump-relay, during the past week, and have much pleasure to report its complete success. I find that, by the aid of the spiral-regulating spring, Flensburg is enabled to interrupt London in the middle of a word, without waiting for more than the ordinary pause; and, from the great reduction of connections and contract-points, there are less chances of local faults occurring.

Taking these things into a little consideration, with the decrease of expenses for local batteries, I would respectfully suggest the same system on all Danish lines.

I am, yours very obediently,
(Signed) W. H. SHAW,
Clerk in charge.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir.—In accordance with Mr. France's request, and with all due respect to both gentlemen concerned in the dispute, I furnish you with the date, by referring to my books, and find I made the first pump relay on the 27th of November, 1860.

I am, Sir, your obedient servant,
R. B. JONES.
Nelson-terrace, City-road,
Feb. 17, 1864.

[Since the above was in type, we have received a letter from Mr. Jones, in which he states that he was in error as to the date, it being the 27th October instead of the 27th November.—This discussion must terminate next week.—ED. T. J.]

[ERRATUM.—In Mr. Bordeaux's letter, which appeared in No. 7, page 83, instead of "for *multiplying* the effects of, &c.," read, "for nullifying the effects of return current."]

A SUGGESTION.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The invitation of your correspondent "H. ELP" to your subscribers and readers to assist in the manner he proposes to make your Journal what its title implies it to be, will I trust meet acceptation. I now and then glance over the pages of the *Civil Service Gazette*, which bear evidence of co-operation on the part of its subscribers and readers in furnishing news, &c., from their respective localities. Brief notices of meetings, appointments, improvements, &c., would greatly contribute to increase the usefulness and popularity of the Journal.

10th February. D. P.

TELEGRAPHIC FEATS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—A "Bell Clerk" says he is surprised at the transmission of Mr. Bright's speech, as remarked upon in your columns, being called a telegraphic feat. Before proceeding further, I fully endorse that opinion; it is indeed a poor speed, "even for the Morse." The Morse instrument must, however, be taken upon its several merits—not only its rate of speed, although that is by no means to be despised. I will undertake to find at any moment a clerk who will transmit a speech or lengthy communication that will be *recorded*, and can consequently be referred to at any future time in case of necessity, at a uniform rate of thirty words per minute, and am persuaded some five or six words more might be added; but it is always advisable to keep within limits, and not make an assertion based upon imagination. The other advantages are numerous. Will the "Bell Clerk" undertake to say he never feels doubtful respecting the correctness of a word in any message he may have received? If he does not feel certain, either the word must be repeated—which repetition takes a considerable portion of the time that would be occupied in receiving another message—or he must *chance*, perhaps, the most important word in an important message being correctly rendered. With the Morse, however, the clerk can look carefully at the word, providing there is any doubt, or the band can be again read over by a disengaged clerk while the other is going on with his duty—another advantage. About seven years ago, when we were not thoroughly experienced in working the Morse, and the instruments were not nearly as perfect as they are now, I recollect the Emperor's speech (in French) being transmitted by a French clerk who did not understand English, and received by an English clerk who did not understand French, at a uniform rate of nineteen words per minute. Giving every credit to the Bells, I doubt whether two English clerks could do this even at the present day. In corresponding, as merchants often do, by cypher, or transmitting messages in foreign languages, and in general correctness, the Morse excels all systems now in use; even in speed, for one, I will not yet yield the palm, taking the ordinary working speed. At one time I used to argue that there is nothing like the double needle; but from experience I say the double needle, although it should ever be remembered as the first instrument to render telegraphy available for general use, ought, with every consideration and regard to the present advanced systems, to be an obsolete instrument. In the first place, there are two wires required for one circuit, consequently the outlay in providing communications is very great, in fact double that required for a single-wire telegraph. Secondly, it is scarcely possible for a clerk to read and write at the same time. The eyes have quite enough to do to follow the motions of the two needles, especially if a great speed is maintained. Again, in cases of contact, the single needle must be resorted to, and clerks working the double needle have little practice in single needle working. On a line where the traffic is great, a contact means very nearly a break down. Upon single-needle circuits, when a contact occurs between two wires, the means of communication is immediately halved; but it is far more than halved with the double needle for the reasons just stated. If needle instruments are adhered to, the Magnetic Company's is undoubtedly the best; but as that requires a writer, the Bells then are much better; consequently, it appears evident the real contest is between the Bells and Morse. If properly worked by efficient clerks, the Morse will be found the speediest, most correct, and the most easily worked system in present use. It is more than likely the Electric Company, who still use the double needle on some lines, are possessed of clerks who, from want of practice, are not yet proficient in Morse working, at least so the telegraphic feat seems to suggest.

I am, Sir, your obedient servant,
AN OLD DOUBLE NEEDLE AND MORSE CLERK.
Dover, 9th Feb., 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Although unconnected with telegraphy as a science or profession, I feel greatly interested in its progress as one deriving considerable advantages from its powers of transmitting intelligence with marvellous expedition and certainty, and would feel exceedingly obliged to you, or any of your readers, if you or they were to explain in your columns how is it that so much difference exists as to the time occupied by the various companies in the transmission of long speeches, as evidenced in the Birmingham and Queen's speeches. It appears from your Journal of the 30th January that the Electric and International Telegraph Company transmitted the Birmingham speeches to London in about five and a half hours, or at the rate of thirteen words per minute. The Magnetic Telegraph Company and staff allege that they transmitted the same matter at the rate of thirty words per minute, and the United Kingdom Telegraph Company accomplished the same work in less than four hours. Again, with respect to Her Majesty's speech, the Electric and International Telegraph Company are represented to have transmitted the speech to several places at the rate of thirty-five words per minute, the Magnetic Telegraph Company at the rate of forty-eight words per minute, and the Submarine Telegraph Company at the rate of less than nine words per wire (five being employed) per minute. It would be very interesting to know the reason why such difference exists in the power of transmission.

Renfrew. P. D. MAXWELL.

SELF-HELP.

To the Editor of the Telegraphic Journal.

Sir,—The remarks of "Amicus" in your impression of the 6th instant are very just, and to the point, when he asserts that the want of self-help is the reason of the subordinate position telegraph clerks occupy, both in society and in literary acquirements.

I have frequently thought that a Literary and Scientific Institution, common to the employés of the various telegraph companies, would exert a great influence for good. I am convinced, if the clerks showed themselves anxious to form such a society, they would secure the support of the various directors in the undertaking, as any scheme having for its object the intellectual improvement of their employés, would naturally claim the sympathy of the shareholders. In conversation with a gentleman, some days ago, I was told that no society—whether for mental improvement, bodily recreation, or pecuniary benefit—formed in connection with telegraph employés, had ever succeeded. I could not contradict his remark, as my experience in the profession was somewhat limited. But when I looked around me, and saw none existing—or, at all events, flourishing—I thought there was some foundation of truth in his assertion. And why should it be so? Other professions have their literary and scientific institutions, and their clubs for recreation—warehousemen, commercial and legal clerks, have each specific societies of this nature, and I think I am by no means presumptuous when I state that, by co-operation and perseverance, we may be able to raise ourselves and our profession to the same level as the other and more flourishing bodies of clerks. But to obtain this result, we must work together harmoniously and methodically, with a single end in view—our mutual welfare: mind, work together—not singly, each by himself, but in thorough, earnest union. A man by himself is a cypher: it is only when he takes his place as a unit in society, that he becomes of value to himself and his fellow men. There is much philosophy in the divine precept, "Bear one another's burdens." For in elevating and promoting the prosperity of those around us, we secure, in like proportion, our own advancement and happiness. A Provident Society for Telegraph Clerks generally has recently been established, and which I earnestly hope will succeed in its objects. One or two institutions of a conservative nature have been formed, in connection with the various companies, for mutual instruction and amusement; but, to meet our requirements, we must have a General Institution, Library, and Club, for all classes of telegraph clerks, irrespective of company. I should like to know the opinions of my fellow employés upon this subject, through the medium of your valuable Journal; and I think, Mr. Editor, it would prove of material assistance to have a few hints from yourself on the best means of promoting the social union and prosperity of the telegraph clerks, of whom I am One of the Least.

RAILWAY TRAIN SIGNALLING.

To the Editor of the Telegraphic Journal.

Sir,—Only that your correspondent, "J. L. Martin," under the above head, adverts to the necessity of a communication between guard and engine-driver, I feared the subject had become a thing of the past—for it is only at the moment we are in imminent danger that we resolve to remedy the future. The powerful arm of the press seems to have achieved but little towards the consummation of this all-important requirement. Though the President of the Board of Trade has asserted that it is a "subject worthy of consideration," yet the different railway companies turn a deaf ear, and will continue on, in their accustomed "penny-wise and pound-foolish" way of doing business. Perhaps, if blood is really shed, railway companies may be again awakened to the necessity of there being some effective "communication" adopted; and, unless the press keeps the subject alive, they will dose off again, only to be aroused by something more serious, if not to them in a pecuniary point of view, to the railway traveller, who, it seems, is to have no remedy, save in case of accident, from the valuable insurance companies. There is not the slightest doubt but that railway travelling has become a terror to most people, and especially to the weaker sex, who avoid travelling alone. What a boon and comfort it would be for railway travellers to know, that where life is in danger, through fire, &c., or when a criminal assault is made, merely the raising of the hand to the roof of the carriage would call the attention of the official in charge of the train. I am convinced that was there a "communication" fixed in every carriage, with instructions as to its use, as well as a quotation from railway bye-laws as to the penalty for abusing it, it would scarcely ever be used (especially in indecent assaults), as the fear of it would deter even the most evil-disposed. "A maniac might misuse it, but the very act would lead to his being secured; and an all-sufficient check upon mischief-making frolic might easily be obtained in a fine commensurate with the real cost of such diversions." It is certainly loneliness that tempts people to make the very numerous attacks upon defenceless females. Adopt some system of "communication," and the temptation becomes removed.

That there are infallible systems of train communication, both electrical and mechanical, in the hands of inventors, is certain—only waiting the time when railway companies shall be convinced that something must be done.

The general recommendation is, that "communication between passenger and guard" is what is wanted; but, for my part, I cannot see the utility of it: for, supposing the passenger communicates with the guard, what assistance can be rendered, without stopping the train? I maintain that a communication between passenger, or guard and engine-driver, is the only thing needful.

Evidently, the real question is one of expense; but would not the outlay soon be repaid? Doubtless, the increase in the receipts would quickly show itself—as the moment safety is secured, the number of travellers will be augmented. Husbands cannot always leave business to travel with their wives; neither can fathers always accompany their daughters. Let it once be certain that aid can be summoned when required, and railway travelling will no longer be dreaded.

Apologising for trespassing so far upon your space, and trusting that the matter will be kept alive, I am, Sir, your obedient servant,

Chester, Feb. 16th, 1864. Fiat.

TELEGRAPHIC NEWS.

We are glad to find that Mr. H. Moor, Chairman of the Mediterranean Extension Telegraph Company, has been returned to serve in Parliament for Brighton.

The venerable Mrs. Somerville, now in her 82nd year, well-known for her valuable work on the *Physical Sciences*, is now engaged in preparing for the press a new edition of the same. Telegraphists owe much to the esteemed authoress. Mr. Fothergil Cooke, some twenty-five years ago, wrote—"The first idea of my mechanical telegraph suggested itself to my mind, on the 17th March, 1836, during my journey from Heidelberg to Frankfort, when reading Mrs. Somerville's work on the *Physical Sciences*."

The Persian Gulf Cable.—Intelligence has been received that two of the vessels, having on board portions of the above cable, had left Bombay for the Gulf; and information is daily expected of the successful submersion of the section, and of the arrival at Bombay of the vessels with the remainder of the cable.

The Great Eastern.—We are informed that negotiations are in progress with the Great Eastern Steamship Company (Limited) for the employment of the ship in the laying of the Atlantic telegraph cable. The ship is admirably adapted for such a service, as from her great length there is an entire absence of pitching. The terms of the proposed charter are highly favourable, and will not only yield a handsome dividend to the proprietors, but leave such a surplus as will refit the ship at the termination of the engagement for any employment which may be determined on.

Magnetic Telegraph Company.—A numerously-attended meeting of the London *employés* of this company was held at their Central Station, 58, Threadneedle-street, on Saturday evening last; Mr. G. C. Newbury, Station Superintendent, in the chair. After a spirited discussion upon the approaching annual picnic and pedestrian handicap, which is arranged to take place in June next, the Chairman called the attention of the meeting to a letter he had received from Miss Oppenheim, Secretary of the Telegraph Clerks' Provident Fund, asking him to solicit the clerks to become members of the said fund. Before doing so he had thought it necessary to carefully study the rules, &c., and, having done so, would now read them, so that the clerks present could discuss their merits or demerits, and come to a conclusion whether they intended joining or not. An animated discussion then ensued, ably sustained by Messrs. Manning, Wild, Stannard, Randolph, and Harper, the meeting finally passing the following resolution:—"After carefully investigating the scales of payment, remuneration, and the rules, regulations, &c., of the 'Telegraph Clerks' Provident Fund,' this meeting is of opinion that the benefits to be derived therefrom are not adequate to those offered by other societies of a like nature, and that the numerous technicalities and requisitions introduced into the said rules debar the majority of telegraph clerks from becoming members." In proposing the health of Mr. Edward Bright, Secretary to the Company, the Chairman said he was happy to inform the meeting of the daily increasing strength and recovery of Mr. Bright, who he was sure was held in the highest esteem, whose illness was watched with the keenest anxiety by all who knew him, and than whom a better secretary could not be found. The toast was drank with loud applause, and the following resolution, proposed by Mr. Randolph, carried amid great enthusiasm, a copy being sent to Mr. Bright:—"That this meeting receives with hearty gratification and pleasure the announcement of Mr. Edward Bright's return to convalescence after so severe an attack of illness, which nearly deprived them of the services of a highly-esteemed and respected secretary; they, therefore, beg most respectfully to offer to him their sincere congratulations upon his recovery, and trust he may long be spared to perform, as ably as heretofore, the duties of Secretary to the Magnetic Telegraph Company." A vote of thanks was warmly accorded to the Chairman, who, in responding, expressed his entire satisfaction at the manner in which the duties of the office had been performed since his accession to the superintendency, and hoped the clerks would continue to uphold the friendship and unity already existing amongst them, which would tend greatly to the successful working of the company's business. The proceedings then terminated. A Discussion and Elocution Class is about to be formed, for which purpose a meeting will shortly be held.

TELEGRAPH COMPANIES.—Numerous complaints have reached the Council of the Huddersfield Chamber of Commerce during the year, as to the errors and omissions in the telegraphic intelligence supplied to this Chamber. The Council entered into correspondence with the Electric Telegraph Company upon the subject, and Mr. C. H. Jones and Mr. Wrigley, as a deputation from the Council, obtained an interview with the company's manager, at Manchester, and succeeded in procuring certain alterations and improvements in the existing arrangements, without additional cost to the Chamber, and which, it is hoped, will place this department on a more satisfactory footing for the future. The Council have also addressed a communication to the United Kingdom Telegraph Company, enquiring when its system of wires would be extended to Huddersfield, so as to make available the cheap telegraphy promised when the support of the Council to their Act of Incorporation was obtained. In reply to this communication the Council have received the assurance that the works of the company are being rapidly completed.

CHIMNEY SHAFT LINES.—We have received information that the United Kingdom Telegraph Company have completed their line to Huddersfield, and a great saving has been effected in house-top work, erection of poles, &c., by carrying the wires through the town on insulators, fastened to brackets inserted in the numerous chimney shafts which abound in the district. An accident, however, occurred before the completion of the work, involving the company in no inconsiderable amount of expense. The contractor, while fixing his ascending tackle to one of the shafts, pulled a large stone from the top which, in its descent, did great damage.

TELEGRAPHIC SIGNALS FOR RAILWAYS.—A very interesting display of various descriptions of electric telegraph apparatus was made at a *conversazione* held at Brighton on the 5th inst. Messrs. Silver & Co. exhibited, among other things, an improved (Ragon's) call-bell. The apparatus is an admirable improvement on the old clock-work alarum, hitherto the only one in use for long circuits, the mechanical arrangements of which were constantly getting out of order. The Ragon's, on the contrary, has no wheel-work, and, therefore, requires no winding up; will ring from any distance, and continue ringing till call is answered—a great desideratum in the electric and railway world. They are in use by railway and telegraphic companies both in England and on the Continent. The electric semaphore instrument, used on the South-Western; the block-over-needle instrument, used on the North-Western, &c.; the needle and bell instrument, used on the London and Brighton Railway, were also shown; this instrument combines efficiency with great simplicity of working, as by a single movement of the handle a current is transmitted through an electro-magnet, which deflects a magnetised needle suspended between the poles, and actuates a rack and pinion, on which is fixed a pointer or indicator that rests on either side of the dial, having the words "clear" and "closed" painted on it; thus, when a train leaves a station the indicator on the instrument at the next station is put over to the word "closed." The current at the same time attracts an armature suspended in front of the magnet, having a stem and knob fixed to it, which strikes a single blow on a ball or gong suspended in the instrument, thus giving notice that a train is on the line between the two stations. This signal is replied to in the same manner, by the signal-man giving one or more blows on the bell or gong of the instrument that sent the signal, by which means each station or signal-box is made aware if the line is clear or closed, as the pointer, once put over, remains so till the opposite signal is sent. Another feature is, that any number of blows can be given on bell or gong without working the needle; thus, any kind of signal can be sent according to a preconcerted code, as three blows for a Brighton train out, and so on. Mr. Funnel, of Brighton, also showed a working model of his patent electric signal-post, which is worked by the passing train putting the signal on and taking it off at any required distance; this is effected by the electric current acting on a train of wheels inclosed in the post, and in connection with the semaphore arm, which it raises or drops. Mr. Funnel proposes to have the clock-work to run a certain length of time, and the posts to be placed at certain distances from each other, by which means the driver or guard of any train will know the exact position of the train ahead. One of these posts is now worked near the Brighton terminus of the railway.

THE INTERNATIONAL PACIFIC RAILWAY AND TELEGRAPH.—The following letter has appeared in the *St. Paul's Press*:—"Grand Trunk Railway of Canada, Managing Director's Office, Montreal, December 24, 1863. My Dear Sir,—I returned from England about a week ago, where I have been for the last two months. . . . . . I have no doubt whatever that the line of telegraph will be completed from St. Paul to Fort Garry, and thence across the Hudson's Bay territory to the Rocky Mountains, and thence to the Pacific. I think I am also safe in saying that negotiations, which are now in progress, with reference to the continuation of the line of railway from St. Paul northwards to Fort Garry, will result in the actual construction of that line of railway before very long, and that steps will immediately be taken to continue the line across to the Pacific coast. I find very great interest existing in London about the Hudson's Bay Company, a line of telegraph, and a waggon road, and, ultimately, a railway; and I have no doubt of the accomplishment, at no very distant date, of these important enterprises. Whilst I was in London I had an interview with his Excellency General Guerbard, who is the Director-General in Russia of the telegraph system of that country. From him I learned many important facts connected with the telegraphic enterprise across Siberia, and found that the construction of the telegraph to the mouth of the Amoor River was a matter not only absolutely decided upon, but in active progress at the present moment. The General appeared to be quite convinced of the probability of the line being continued from the Amoor River, by way of Behring's Straits, to the borders of British Columbia; and, from the information which I have derived from him, I do not think we shall have as much difficulty or anything like it in connecting St. Paul, by way of the Hudson's Bay territory and the Rocky Mountains, with the northern boundary of British Columbia, as the Russian Government have experienced in the lines of telegraph which they have made across Siberia. Yours very truly, C. J. BRYDGES.—J. W. Taylor, Esq., St. Paul."

AUSTRALIAN TELEGRAPHS.—We quote the following intelligence from the *Sydney Morning Herald*, of the 21st December, ult.:—"All the more important towns in the colony being connected with Sydney by the telegraph, there are few works in progress for the extension of telegraphic communication, and the lines now proposed are mostly those the interest of the cost of which is guaranteed to the Government, by the residents in the districts through which they are to pass. A second wire, between Sydney and Newcastle, upon the old posts, has been completed and brought into use during the last month. The line connects Windsor, Wollocombe, West Maitland, Morpeth, and Newcastle, with the metropolis, by a separate circuit. For the old line, a submarine cable was laid across the Hawkesbury, but the two wires are now stretched between masts 100 feet high above the river, the distance between the masts being about one-third of a mile. The cable is, however, still available in the event of the other wires not being found to answer. Upon the extension from Deniliquin to Hay, the wire is stretched as far as Conago, twenty miles from Deniliquin, and the poles are up for a distance of twelve miles beyond. Arrangements have been made for continuing the wire from Braidwood to Queanbeyan, and the contract for the work has been taken by J. Murphy, Esq., to be completed in three months. The extensions proposed, in the estimates for 1864, are from Mudgee to Murrandi; from Brardwood to Morruya, *viâ* Arulen; and from Kindra to Cooma. In the supplemental estimates for 1863, there is a sum proposed for a private line to Mimi, a distance of six miles.

MISCELLANEA.

SELF-CULTURE.—The education received at school and college is but a beginning, and is mainly valuable in so far as it trains us in the habit of continuous application, and facilitates self-education after a definite plan and system. To enable the mind freely to exercise its powers, it is necessary, even under the most thorough system of culture, that there should be occasional gaps for its free operation. Thus left in some measure to find out what it can do, and what it cannot do, it will gain in strength and activity, and the evils arising from a too entire dependence on the teaching of others will be in a great degree avoided. Often the best education of a man is that which he gives himself, while engaged in the active pursuits of practical life. Putting ideas into one's head will do the head no good, no more than putting things into a bag, unless it re-act upon them, make them its own, and turn them to account. "It is not enough," said John Locke, "to cram ourselves with a great load of collections; unless we chew them over again, they will not give us strength and nourishment." That which is put into us by others is always far less ours than that which we acquire by our own diligent and persevering effort. Knowledge conquered by labour becomes a possession—a property entirely our own. A great vividness and permanency of impression is secured; and facts thus acquired become registered in the mind in a way that mere imparted information can never produce. This kind of self-culture also calls forth power and cultivates strength. The self-solution of one problem helps the mastery of another; and thus knowledge is carried into faculty. Our own active effort is the essential thing; and no facilities, no books, no teachers, no amount of lessons learnt by rote, will enable us to dispense with it. Such a spirit infused into self-culture gives birth to a living teaching, which inspires with purpose the whole man—impressing a distinct stamp upon the mind, and actively promoting the formation of principles and habitudes of conduct.

THE following Table, by Professor Mathiessen, F.R.S., shows the conducting-power of some of the pure metals, thus:—

	Conducting power at 0°.
Silver (hard drawn)	100·00
Copper "	99·95
Gold "	77·96
Zinc	29·02
Cadmium	23·72
Cobalt*	17·22
Iron*	16·81
Nickel*	13·11
Tin	12·36
Thallium	9·16
Lead	8·32
Arsenic	4·76
Antimony	4·62
Bismuth	1·245

* Probable value for the pure metal deduced from the observations with the impure one.

The First Practical Introduction of the Electric Telegraph.—It has generally been received as a fact that the electric telegraph owes its first practical introduction as a medium of communication to its having been the means of the capture of the murderer Tawell on the 1st of January, 1845. We are in a position to prove that its extraordinary capabilities were practically exemplified under more favourable and pleasing auspices. An original document now lies before us, a copy of which appeared in the *Times* on the 15th of April, 1844 :—"The first intelligence of the arrival of His Royal Highness Prince Albert in this country from Germany, on Thursday last, was communicated to Her Majesty at Windsor Castle by means of the galvanic telegraph on the line of the Great Western Railway. Within one minute of the arrival of His Royal Highness at the Paddington terminus the information had reached Slough, at which station a special messenger, mounted upon one of the fleetest horses in the Royal stables, was stationed by command of the Queen, and who proceeded with the gratifying intelligence to the Castle, where he arrived in eight minutes and a half from the time of his leaving Slough. Thus the news of the Prince Consort's return to England reached Her Majesty and their Majesties the King and Queen of the Belgians in less than ten minutes after His Royal Highness had arrived at Paddington, and forty minutes before the Prince had reached the Royal residence at Windsor." Its great practical value was, however, permanently established as a "means of communication between distant places," by the successful transmission of Her Majesty's Speech in the month of February, 1845, from London to Portsmouth.

Application of the Electric Telegraph suggested in 1836.—The cases in which the convenience of individuals would be affected are innumerable ; and perhaps there are few persons, however generally unconnected with the transactions of the busy world, who would not sometimes be spared either a lengthened epistolary correspondence or an expensive journey, by a few short communications through the telegraph. The comfort of friends and relations, far distant from each other, would often be materially involved, especially in cases of sickness ; and it may not be too much entering into detail to specify that particular instance, where sickness appears hastening towards a fatal termination with such rapidity that a final meeting is without the range of ordinary means. Though the application of the telegraph to private affairs is less dazzling than that to Government and commerce, it is perhaps not less intrinsically valuable, as equally tending towards the one and only justifiable object of all establishments—the aggregate of comfort and happiness to the nation. It may here be observed, that should it at any time be desirable for the Admiralty, in their communications with vessels lying off telegraph ports, to convey their dispatches direct during the night, the apparatus in ordinary use, conveniently situated facing the sea, may, by a peculiar adaptation of the hydro-oxide lime burner, arranged for this instrument, extend their correspondence many miles across the water. Even His Majesty's navy might be furnished with instruments of a simpler arrangement than that proposed for land service, to communicate signals during the night, the action of which would not be interrupted by the motion of the vessel during bad weather. For short distances of a few miles, a powerful argand lamp would answer this purpose effectually.—*Mr. Fothergill Cooke's Pamphlet.*

RECENT PATENTS:

1620. William Andrews, of 237, Gresham House, Old Broad-street, London, "Improvements in Apparatus for Insulating Electric Telegraph Wires." Dated 29th June, 1863.

This invention has for its object improvements in apparatus for insulating electric telegraph wires. For these purposes, in addition to the ordinary insulating apparatus or instruments used for supporting electric telegraph wires, the arms and brackets at the parts where such insulating apparatus or instruments are applied are kept free from moisture by a peculiar construction and application of sheds or covers, which are open at the bottom. When projecting arms are used fixed to uprights, the outer ends of such arms, where the ordinary insulators for supporting the wires are applied, have inverted box-like sheds applied. These sheds are made of glazed earthenware or other suitable material ; they are closed at top, at the two sides, and at the outer ends, and such sides and ends descend below the under surfaces of the arms. The sides, ends, and tops of these sheds do not come in contact with the arms, but narrow spaces are left between the inner surfaces of the sheds and the outer surfaces of those parts of the arms where such covering sheds are applied. The inner ends of the sheds are either open or partially closed, and grooves or recesses are made all round the arms where the inner ends of the covering sheds come ; hence, any rain or moisture which may fall on the other parts of the arms beyond where the covering sheds are applied will be prevented flowing or passing to the outer ends of the arms over which the covering sheds are applied. When brackets are used, and the outer ends thereof rise above the level of the inner parts of the brackets, then the covering sheds come all round the outermost ends of the brackets, but the sheds are open at bottom. When the wires are supported by insulating instruments or apparatus above the arms, then the bolts or pins, on which the supporting insulators or instruments are received, pass through the upper parts of the inverted sheds into the arms, and such bolts or pins are coated with insulating materials, or they are otherwise well insulated.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.		
Genuine mixed, first and second qualities .	2/3 to 2/6	per lb.
Good re-boiled	1/7 to 1/10	„
India Rubber.		
Para, first quality	1/10 to 1/11	„
second „	1/7 to 1/8	„
third Negro-head	1/2 to 1/3	„
Java and Penang	1/4 to 1/6	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	104 to 107 x. dv.	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	¼ to ½	—
5	United Kingdom Telegraph .	8	½ dis. to par	—
10	Mediterranean Extension Tel. .	all	3½ to 4½	—
5	London District Telegraph Co..	all	1 to 1½ [& ex.n.]	—

TO CORRESPONDENTS.

J. C. L. is thanked for his communication. The subject referred to will receive our best attention.

H. D.—The following books will be especially serviceable to you :—"Bond's Handbook of the Telegraph," "Ganot's Elementary Treatise on Physics," Miller's "Elements of Chemistry and Physics," vol. i., and "Stockhardt's Rudiments of Chemistry." London : J. Spon & Co., Bucklersbury.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand ; Messrs. Dawson & Co., Cannon-street, E.C. ; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester ; at the various railway stations ; and of all news-agents, &c., &c. ; or it can be supplied, if preferred, direct from the Office on the following terms :—

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TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

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THE TELEGRAPHIC JOURNAL.

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INDIAN TELEGRAPHY.

THE introduction of the electric telegraph into British India, by Sir W. O. S. Brooke, F.R.S., has conferred upon that vast empire advantages of the highest importance, both in a social, commercial, and political point of view. In conducting the affairs of a country where the principal seats of government are so far asunder, the possession of an instantaneous means of communication must at all times be exceedingly valuable. Sir William, in his last Report on the Electric Telegraph in India, previously to his departure for Europe, in 1861, on medical certificate, gives a most interesting account of the extent and the general working of the system. At that period, there were 10,994 miles of telegraph, and 136 offices open for public correspondence. Several offices had been closed during the year, as no longer necessary for military or public purposes. The rapid decay of the timber-posts was the source of much trouble and expense,—the mean duration of such supports being about five years,—and measures were in progress for the supply of iron standards, for all India, of which 40,000 had already been erected, and which had given the utmost satisfaction. The earthenware insulators, however, caused much annoyance and many interruptions—continually breaking, from their weakness and brittleness. The instrument employed was that of Morse, and the signals, in most cases, were read from sound, as long has been the case in America. The total number of private messages sent in all India, Pegu, and Ceylon, in 1858-59, was 101,164; and in 1859-60, 170,566; of service-messages in the same periods respectively, 56,670 and 31,868 — showing that a reduction in the number of the latter had been satisfactorily effected, while an increase in the former of 68·61 per cent. had taken place. The value of the service-messages was, in 1858-59, 3.64.739 rupees; in 1859-60, 1.20.169 rupees. The number of messages sent by *native* merchants and correspondents, during the two years was—in 1858-59, 39,724; in 1859-60, 71,544. This increase was considered very important, as the European community was comparatively small, and might not be capable of affording a very large increase of business. The native bankers and merchants, and community generally, could give as much work as the lines could ever perform. The telegraph staff of India, at the same period, consisted of one chief superintendent, three divisional superintendents, nine deputy superintendents of circles, and upwards of 1,100 inspectors, assistants in charge of offices, signallers, probationers, accountants, clerks, writers, &c., exclusive of line and cable guards, and office servants of all kinds. The difficulties which the Director-General of Telegraphs in India had to contend against in the management of a staff so numerous and so widely dispersed over the country were very great.

In speaking of the progress of the lines, he observes, that great reductions will be practicable in the number of the employés as fast as iron posts were provided for the lines, as one-half of the establishment of line-inspectors, artificers, and overseers, and several hundred of line guards and mounted patrols, would be discharged, at an estimated saving of 40,000 rupees per month on establishment only, and further adds, "a great number of accountants, clerks, and writers, might be discharged at once, with much advantage to the public service. Half of them are worse than useless, but the difficulty of getting rid of these persons is very great. They fasten upon public departments with a tenacity inspired by the enjoyment of sinecures and the prospect of pensions. To attempt to dislodge them is followed by appeals to Government and outcries about cruelty and persecution, so that the reformer and economist soon finds himself an object of popular execration. All this is very disagreeable, but the duty must still be performed." It appears that the total cost of the establishment for all persons drawing more than ten rupees per month, amounted to 68,310 rupees, and the house-rent, the Bengalore workshop, line and cable guards and peons, including the salaries and wages, amounted to 88,121 rupees. The total expenditure of the department for the financial year 1859-60, exceeded 17.20.427 rupees, included the expense of the construction of several new lines.

Sir William concludes his interesting report in the following emphatic words :—"There is a great future before the Telegraph in India. By perseverance and determination it should be made the best in the world, inasmuch as it possesses an unity of organization unattainable elsewhere, with all the resources of the empire to promote its extension and improvement. In two, or at most three years from this time, the lines should yield a clear profit, and an uniform minimum charge for messages may then be adopted for all India. This, with the general use of some simple cypher by habitual correspondents, will enable the Telegraph to perform much of the present business of the post-office. Meanwhile, we have at our disposal, at a moderate cost, an instrument of such miraculous power that, by a single message, it has already saved our Indian Empire; while day by day, and hour by hour, it is busy in the promotion of commerce and the furtherance of private interest of every kind. In my extended tours over all parts of India I have seldom met a family who had not some anecdote to tell of the services the Telegraph had done them. There are few Europeans in India who have not experienced a thrill of pleasure when they meet our masts and wires on the margin of every road, and know that these true tokens of science, and civilization, and power, traverse our Indian Empire to its utmost limit. Should I see them no more, I can truly say that I shall ever continue to take the most heartfelt interest in the prosperity and improvement of the department, and feel proud and happy that it has been my lot to bring it even to its present imperfect state."

However, India is still inadequately supplied with Telegraphic communication, although the Government has made great progress in extending its lines. The commercial community is anxious and ready to support any well-organized system, such as the one now proposed, which is to be similar in its constitution to the Telegraph Companies of England, and to be carried out by the Oriental Telegraph Company, which proposes to commence its lines at Kurrachee upon the completion of the Persian Gulf line, and working from thence towards Bombay, Calcutta, and other important cities in India.

A PLEA FOR THE CLERK.

CARLYLE, in one of his brilliant essays, affirms that "labour is worship;" and other authors, distinguished for the elegance rather than the utility of their productions, are frequently pleased to expatiate upon "the dignity of labour"—a piece of sentimental phraseology which might serve as a keynote to suggestive argument, but which is more often used to minister

to a very general vanity, leading the reader to a conception of his own superlative merit, and society's incapacity to appreciate talent. To these rhapsodies we attach but little importance. We desire to be eminently practical, and, of course, can only be suggestive. It will be readily conceded that every man, who faithfully labours in the sphere in which he finds himself, is entitled to the respect and consideration of those who occupy more exalted and influential positions; and this is what we claim for the clerk. It is only to be expected that gentlemen who invest capital largely in telegraphic enterprises should look for some return; but we insist that the system of grinding down the employés of public companies, in order to realise dividends for shareholders, is a very questionable proceeding, which will be sure to entail evil consequences.

Those who are at the present time engaged as instrument clerks are generally well-educated, are expected to maintain a decent exterior, and to devote themselves exclusively to the service of the company by whom they are employed; the consequences of any breach of confidence, by those who are entrusted with the secrets of the cabinet, the interests of all our banking concerns, and the commercial transactions of the country generally, cannot be estimated. But what will be thought of the remuneration received for the fulfilment of these requirements, when we reveal the fact that they do not receive more than from 16s. to 25s. per week. Artizans combine to represent the insufficiency of their wages, and sometimes make demands which few employers can concede—a reprehensible proceeding, but one which enables them to make known their grievances. Now, the telegraph clerk has not, from the isolated nature of his occupation, opportunity or means of communication with his fellows, whereby he may be enabled to effect improvements in his condition, but is under the necessity of living and bearing with his miserable pittance. Granted that opportunities are often presented, which enable the diligent and persevering among them to rise from the ranks. It is not individual advancement that is needed so much as a generally commensurate payment for services rendered. We have received so many communications from all parts of the kingdom, enquiring, "Can't you do something for us poor clerks?" "Would it be out of your power to direct the attention of shareholders to the illiberal wage paid to instrument clerks?" &c., that we are persuaded there is something wrong in the working of our telegraph system, or complaints would not be so general.

Here is a large class of educated, respectable persons, without any means of association for mutual protection, complaining of their inadequate pay. What is be done with them? The counsel of our Foreign Secretary, "rest and be thankful," is a very good general recommendation, but is a mockery when given to underpaid servants. It is useless to advise a study of the principles of political economy as a means of reconciling them to their position. Political economy is, unquestionably, against them, and they can hardly be expected to hearken; the market law of "supply and demand" is inapplicable to men who have necessities, responsibilities, and human ties. What is required is a sympathetic consideration from those who are called upon to rule over them.

How to determine the relative condition of employer and employé is one of the most perplexing problems ever contemplated by the human mind, and we will not venture beyond the region of kindly recommendation in any remarks we have to make. The telegraphic enterprise, like many other useful projects, may have been hitherto overwrought., *i.e.*, there may be more companies in England than are absolutely useful, and the business of the country divided amongst them may not prove very advantageous to either; but on this point we hesitate to express an opinion, seeing that the mass of the people have not yet recognised the immense utility of the system. It is evident that, with a limited amount of business, justice is not done to all parties engaged in telegraphic pursuits. Shareholders, solicitous for dividends, exert an influence upon directors and managers, who are obliged to appear inexorable whenever appeals are made to them for increased salaries, and thus those whose requirements are greatest are compelled to suffer.

A remedy for this condition of things is very necessary. We do not desire to unduly exalt the claims of the clerk, nor to ignore the just expectations of shareholders. We submit that a more speculative business would prove advantageous to all the companies, and recommend that special éfforts be made to secure the support of the public for the telegraph system. Existing lines might be made more productive, without any appreciable increase of working expenditure, and the profits so derived would admit of a better remuneration of the staff. What would the postal service of this country be were its advantages confined to the merchant and the manufacturing classes? The answer to this query is to be found in the fact, that instead of being a source of immense revenue to the Government, it would realise a comparatively trifling income, as telegraph companies are doing at present. Hence we are convinced that were vigorous efforts made to popularise telegraphy, resources would be placed at the disposal of directors and managers, who would not only be able to declare larger dividends, but to augment the salaries of their underpaid officers.

SUBMARINE CABLES.

III.

Mr. Latimer Clark submitted a cable for experiment of the following description:—An insulated copper wire or core served with steel wires, having a slight spiral direction, and covered with tape and a composition of shellac and marine glue. A cable of this description was weighted to 1,787 lbs.; the extension before removing the weight was = ·468 per cent., the permanent elongation = ·364 per cent., and the return, or contractile force = ·104 per cent. The Liverpool and Isle of Man cable is constructed upon the above principle, with the exception that iron is substituted for steel wires. Upon some portions of the cable being recently raised for repair, in consequence of its severance by a ship's anchor, the iron sheathing protected by the compound was found to be in a perfect state of preservation. The Wexford and St. David's Head, the Zandvoort, and the Persian Gulf cables are similarly protected against corrosion by coatings of mineral pitch, silica, and Stockholm tar, in the proportions of 34, 56, and 10 parts respectively. The last of the three cables, after the iron wires were laid on, had two coatings of the compound and two servings of tarred hemp yarn laid alternately, the first coating of the compound being next to the wires, then a serving of yarn, then compound again, and lastly yarn.

Messrs. Siemens, Halske, & Co. submitted a specimen of cable of novel construction—viz., a gutta-percha core covered spirally with fifty-six strands of hemp, and lapped with copper. The cable was weighted to 2,256 lbs.; the extension before the removal of the weight was = 1·75 per cent., the permanent extension after removing the weight = 1·15 per cent., the return, or contractile force = ·60. It had a specific gravity in water of 1·5, and possessed great tensile strength. The Oran and Carthagena cable, which has already been described in this journal, was constructed upon the same principle as the above, but much improved with regard to increased strength.

Several specimens of the proposed deep-sea portion of the then intended Gibraltar cable were furnished by Messrs. Glass, Elliot, & Co. The core consisted of a strand of seven copper wires, covered with three coats of gutta-percha and Chatterton's compound, weighing 800 lbs. per mile. The core was covered with twelve strands of steel wire and hemp, each strand consisting of one wire with six yarns of tarred hemp. This cable was weighted to 3,596 lbs.; the extension before removing the weight was = 1·927 per cent., the permanent extension after removing the weight = 1·197 per cent., and the return, or contractile force = ·73; specific gravity

in water, 1·9; external diameter, $\frac{11}{16}$ths of an inch. One of the specimens, similar to the above in every respect, with the exception of the steel wire being gauge 14 instead of 17, was not broken with a weight of 13·043 lbs. = 5,683 fathoms in length of its weight in water. A third specimen, having the same number of iron wires as the above, broke with a weight of 11,311 lbs. In testing this cable when it had a weight of about 10,000 lbs. attached to its lower end, the splicing at the top of the triangle gave way, and the consequent contraction of the iron wires acting upon the permanently-elongated core caused it to force itself through the strands of iron wire. Numerous experiments were made as to the liability of the various ropes we have enumerated to form themselves into kinks in the operation of uncoiling. We found it difficult to effect kinks in such cables as those of Allan, De Bergue, Clark, Wells & Hall, and Sinnocks, while in the other cables we found it as difficult to prevent the same taking place, and which could not be removed by tension, the core being forced between the iron wires, and the cable generally breaking at the kink. The untwisting of the ropes when subjected to tension was also observed—the cable being suspended from a triangle, its upper end being fixed and the lower end, to which the weight was suspended, being allowed to revolve. The number of revolutions with a weight of 1,787 lbs. on the Gibraltar cable was 1¾; Godefroy, 0; Silver & Co., 0; Wells & Hall, 0; Siemens, with 2,258 lbs., 1½; Allan, with 1,787 lbs., 0; Sinnocks, 1½; De Bergue, 0; Clark, 0.

THE MAGNETIC RHEOMETER.

THE method of measuring inductive charges and discharges by the momentary deflections of the needle of a galvanometer, requires the employment of batteries of considerable electro-motive force, or wires of great length, in order that the charge may be accumulated, or galvanometers of extreme multiplying power. For this purpose Professor Wheatstone recommends the employment of Mariani's Rheo-electrometer, or Magnetic Rheometer. The instrument is thus constructed:—Five yards of insulated copper wire, 1-120th of an inch in diameter, coiled round a cylindrical bar of soft iron, three inches in length and one-eighth in diameter; this bar is fixed horizontally, over a graduated circle, at a right angle to the line joining its zero points; at the centre of the bar there is an aperture, to allow the free passage of a silk fibre, from which is suspended an extremely delicate magnetic needle, weighing less than half a grain; at the top of the glass cage the upper end of the fibre is attached to a pin, which, by means of an adjusting screw, may be raised or depressed without causing it to rotate, in order to regulate the distance from the needle to the electro-magnetic bar. The ends of the coil of wire are connected to binding screws, placed outside the frame, and the graduated circle with the bar is moveable by means of a lever placed beneath the frame, in order that the zero points may be accurately brought to the magnetic meridian, without moving the instrument bodily. Four small pins are fixed on the circle, in the vicinity of the bar, in order to prevent the contact of the needle with the bar, which it would be otherwise sometimes difficult to disengage from each other.

The mode of using the instrument is as follows:—The zero line of the scale is brought, by means of the lever, into the magnetic meridian; if then the bar is entirely deprived of magnetism, the needle will place itself in that direction. On a discharge being made through the coils, the bar becomes magnetic, in proportion to the amount of the discharge; the two poles of the needle are attracted towards the two ends of the electro-magnet, causing an instantaneous deflection, and, subsequently, a permanent deviation, owing to the residual magnetism to a less amount. To prepare the instrument for a fresh experiment, the bar must be deprived of its magnetism, which is easily effected in the following manner:—One of the poles of a very weak single cell of a voltaic battery is to be attached to one of the binding screws of the instrument, while the other pole is to be brought into successive momentary contacts with the other binding screw, the current being in the opposite direction to that which produced the magnetism of the bar; each contact causes the approach of the needle towards zero, and when it has arrived at that point the magnetism of the bar is completely destroyed, but should the zero be overpassed, the same operation must be repeated, after inverting the current.

The following experiments were made with this instrument:—A Leyden jar, having 380 square inches of tinfoil surface, was charged by a Daniell's battery of 512 elements. On discharging the jar, the Rheo-electrometer showed ten degrees instantaneous, and four degrees permanent deflection. One hundred yards of copper wire, coated with gutta-percha, and immersed in water, were charged by a battery of sixty elements; when the discharge was made through the Rheo-electrometer, a deflection of several degrees was shown. In this case the discharge current could not be detected, except upon a suspension galvanometer of 30,500 coils.

RAILWAY TRAIN SIGNALLING.

UPON the first introduction of the Electric Telegraph as an instantaneous means of communication, it was fully expected that it would be speedily adopted for the above purpose, and that it would be of great advantage to the railways then extending themselves over Great Britain; but, as is usually the case with great inventions, many years elapsed before the invention was practically applied for the purpose of Railway Signalling, notwithstanding the vigorous and indefatigable efforts of the patentees to prevail upon engineers to recommend it for their lines. We have now before us a Blue Book, containing the Report of a *Select Committee* appointed to consider "whether it is desirable, for the public safety, to vest a discretionary power of issuing regulations, for the prevention of accidents upon railways, in the Board of Trade, &c.;" also the Minutes of Evidence taken before the Committee, occupying, altogether, no less than 210 folio pages. The volume contains a vast amount of information respecting the system of signals then employed, and also suggestions for improved methods of signalling, but no one ventured to suggest the application of electricity for the purpose; indeed nothing could be more discouraging than the brief allusion made to the electric telegraph, by the then Inspector General of Railways. We quote the questions, and the answers given:—

"Sir JAMES GRAHAM.—At this moment there is on the Great Western an electrical telegraph, is there not, from the point of starting to the first station out of London? Sir F. SMITH—I know that there was; I am not sure whether there still is.

"That telegraph, it is stated, is of use to prevent trains approaching the station at moments of danger?—It might be used in that way; I am not aware whether it ever was so used.

"Do you suppose that telegraph communication, being established on that line, to be of an experimental nature or not?—I should think it utterly impossible for the Government to force any company to adopt a regulation of that kind.

"If it was a practice on that line, and is conducive to the public safety, why should you say it may not be enforced?—Because I should say the public safety might be secured at a much less expense.

"But still the Board of Trade might say, 'We have the experience on the Great Western Railway, of this telegraph being conducive to public safety;' would it not be in their power, as the clause is now drawn, to prescribe that regulation, relying on the practice, and not regarding it as an experiment?—I think it might tend to cramp the commerce of the country, now carried on very much by railways, and that it would be too expensive an expedient to compel the recourse to it.

"That is a question of policy; but, under the clause as it now stands, would not the Board of Trade have a right to interfere?—I think they would have a right to interfere; but they must have their proceedings taken notice of by Parliament, and I do not see how any Government could support such a proceeding.

"You think a telegraph communication might be ordered on any railway?—We are now looking at the question of power, not its application; and as the clause stands, perhaps the President of the Board of Trade might have power to issue such a regulation, but one can hardly conceive the possibility of anything so absurd as his exercising it."

The following engineers were examined as to the system of signalling employed, all of whom ignored even the existence of the electric telegraph:—Mr. Loch, C.E.; Mr. I. K. Brunel, C.E.; Mr. G. Stephenson, C.E.; Mr. E. Bury, C.E.; besides a number of managers and secretaries. The appendix also contains resolutions respecting signalling, &c., passed at a meeting held at Birmingham on the 19th January, 1841, at which were present

deputations from various companies, representing a capital of fifty millions sterling. The following is a copy of the first and principal resolution:—"That in consequence of the public anxiety, occasioned by the accidents which have taken place on various railways, the companies here represented, in order to profit by the combined experience of the principal lines, have deemed it expedient that a general conference should be held, for the purpose of taking into consideration the causes and circumstances of such accidents, and the means that may be available of more effectually guarding against their occurrence for the future."

Every possible means were suggested for "guarding against the occurrence of accidents," except that of the electric telegraph, although its applicability for the purpose was, and had been well known to several of the engineers and managers present at that meeting, but the invention, not having had its origin in our favourite Westminster, "found no favour in our eyes." We shall, on a future occasion, explain how telegraphy became a "branch of our profession."—C. E.

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(Continued from page 89.)

2. *Sending Keys, or Instruments with which the Signals in the above Codes are sent by hand.*

Morse signals are usually transmitted by a simple rocking lever, worked up and down by hand between two stops. The lever is in connection with the line, and one stop with one pole of the battery. The other stop used to be a blank, but is now, with the best effect, generally connected with the earth, and serves to discharge the line. Messrs. Siemens, Halske, & Co., for work through submarine cables, connect it with the opposite pole of a second battery.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2,864), exhibit an excellent finger key, or, rather, pair of keys, by which the reverse voltaic currents, required for the Steinheil, or similar codes, can be sent with great rapidity and little fatigue to the operator. Two flat spring keys are placed side by side, one for the positive and the other for the negative signals; in their position of rest, the current sent from the far station can pass through the near receiving instrument to earth, but when either of the keys is depressed the near receiver is first cut out of circuit, and the positive or negative end of the battery joined to the line, and the other pole is put to earth. This key is used either in connection with the needle instrument, or with the acoustic telegraph, to be presently described.

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit a magneto-induction key, by which signals can be sent through circuits of great length without the use of any battery. The handle of the key is worked in exactly the same manner as the common Morse rocking lever. The adoption of their polarized receiver, which will presently be described, has allowed these instruments to be used for the transmission of common Morse signals, and may lead to their extensive use.

The arrangement of the magnet and coils, by which the reverse currents are induced, is extremely simple and good. A series of horseshoe magnets are placed side by side, separated by spaces of about the same thickness as the magnet plates. A soft iron bar with an H cross section is placed between the poles of the magnets, and is supported on a longitudinal axis allowing a partial rotation to be given to it by a handle. The wire of the induction coil is wound longitudinally round the bar from end to end parallel to its axis, and consequently crossing the planes of the magnets at right angles. The coil is protected outside by a brass plate, and the iron bar, coils, and brass plates then form a long prism of rectangular section, supported at the ends by two bearings. This rectangle very nearly fills up the space between the poles of the magnets, so that the handle, which is on the axis, can only turn the bar through a very small angle. When the handle is up, two diagonally opposed corners of the rectangle are in contact with the two poles of the permanent magnets, and these magnetise the bar transversely in a given sense. When the handle is depressed, the two remaining corners on the other diagonal are brought against the poles, and the bar transversely magnetised in the opposite sense. In other words, as the handle is worked up and down, the opposite poles of the permanent magnet are alternately brought in contact with the same end or head of the H iron, although not with the same corners. The change of magnetism in the iron induces the required reverse currents in the coil, one end of which is connected with the line and the other with earth. The handle is worked in exactly the same manner as the usual voltaic Morse lever, but requires, of course, more power to work it, since the current obtained is really the equivalent of the power exerted.

The handle moves through a very small arc—a great advantage to the operator; and the arrangement generally has some other advantages which will be pointed out when Messrs. Siemens' step-by-step dial instrument, worked by similar coils, is described. A key of this kind worked a direct acting ink-writer with a resistance in circuit equal to 468 miles of No. 8 iron wire.

W. T. Henley, H. M. (United Kingdom, 2,908), also exhibits a magneto-key, in which he uses the same arrangement of permanent magnet, soft iron armatures, and horseshoe with coils, as in his step-by-step magneto-transmitter, which will be presently described. He requires three soft iron armature pieces, one opposite the upper soft iron pole, and two opposite the lower pole. The reciprocating motion of the key allows these three armature pieces to produce the same series of alternations of polarity in the soft iron horseshoe as are produced by the continuous motion of the rings in the step-by-step instrument. The key exhibited worked a direct acting ink-writer, exhibited by Messrs. Siemens, with a resistance equal to that of 468 miles of No. 8 iron wire in circuit. These two magneto-keys can obviously be used in connection with needle-receiving instruments, to which, indeed, magneto-keys were first applied.

The Telegraphen Werkstätte, of Berne (Switzerland, 151), exhibit an ingenious key for the transmission of Morse signals by the secondary currents of an induction coil. One current—say the negative—is used to produce the marks, and the other, or the positive, the intervals. It is intended to be used in connection with a Morse receiver or relay, having what may be called an unstable armature, which will remain in either position to which it is moved by a positive or negative current, even after the interruption of that current. A receiver of this kind can only be worked by alternate positive and negative currents, and the armature, in moving from one stop to the other, necessarily passes through a position in which, when no current is passing, it would be in unstable equilibrium.

The positive and negative secondary currents sent by this key are of equal strength, and both produced by the interruption of the primary current. A single battery only is used; this battery is never in a short circuit, and is closed through the primary coil for a very short time during each signal. These desirable results are obtained by very simple means.

The key consists of a rocking lever worked like that of the usual Morse key, with two contact pieces, which will be called A and B, at the two ends of the lever, both on its upper side. The lever is connected by its axis with one pole of a battery. A second lever, immediately over the first, rocks on an axis parallel to that of the first, and has two insulated contact pieces, A′ and B′, on its lower side, facing A and B of the first lever. This second lever is made of a magnet or magnets, and two armatures of soft iron are fixed immediately over the poles, which are themselves immediately over the two contacts, A and B. These armatures are used, as will be seen, to attract the second lever into one of two extreme positions, and to hold it there until removed by the first lever. The two insulated contact pieces, A′, B′, are both connected with the other pole of the battery by means of two distinct insulated wires wound in opposite directions round the core of the induction coil, and forming two distinct primary coils. One end of the secondary coil is connected with the line, and the other, through the home relay, with the earth.

By this arrangement a contact between A A′ sends, say, a current from right to left round the induction coil, and a contact between B B′ sends a current from left to right round the coil from the same battery, but through a separate wire. The position of these several parts is so adjusted, that when the first lever is at rest neither of the contacts, A A′ or B B′, is completed; but one end, say B′, of the second or magnet lever rests against its armature. When the first or hand lever is depressed it first makes contact between A A′ (at the opposite end of the magnet bar). This closes one of the primary circuits, sending a current from right to left round the induction coil, and so induces, say a positive secondary current in the line. It will presently be seen that this current, being in the same direction as that which must have preceded it, does not move the armature of the receiving relay or instrument; in fact, it produces no visible effect at the receiving end of the line. As the downward motion of the hand lever continues it next removes the end, B′, of the

magnet lever, and when it reaches its limiting stop, it has brought the opposite end, A′, so near to the other armature, that it springs up, breaking the contact, A A′, made shortly before. This interruption induces a current in the secondary coil opposed to that last sent, or transmits, say, a negative current through the line, and so moves the armature of the receiving instrument from the position in which it had been left by the last positive current, and produces a mark or sign. When the hand lever is allowed to rise it shortly completes the contact, B B′, and sends a current from left to right round its primary coil; the current induced in the secondary coil is in the same direction as that last sent, resulting from the interruption of a current flowing from right to left; it therefore produces no visible effect on the receiving instrument. As the rise of the hand lever continues, it removes the end, A′, of the magnet lever from its armature, and when it reaches its limiting stop, it has brought the end, B′, so near to its armature, that it springs up to it, breaks the primary circuit, and so induces a positive secondary current, which moves back the armature of the receiving instrument, and produces the space or interval following the mark.

Thus, when the first lever is worked by hand, four successive currents are induced in the line; the first and fourth are positive, the second and third negative; the second and fourth are currents by interruption, and they alone work the receiving instrument, the armature of which is unmoved by the currents of the same name which follow. It will be observed that the two primary circuits are only completed for a very short time during the motion of the hand lever, and that both in the upper and lower position of that lever the two ends of the battery are insulated from one another.

The sending clerk sends through his own receiving instrument, which is a disadvantage; but, on the other hand, he can in consequence be interrupted at any moment by the clerk at the far end.

This key is ingenious, and would, no doubt, fulfil its objects in practice; it is much superior to those induction keys in which the alternate currents are unequal, but it does not clearly appear what advantage is expected over the usual voltaic or magneto-electric signals.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2,864), exhibit the only instrument designed to remedy in any way the retardation or interference produced by induction in long submarine cables on the signals transmitted through them. This instrument is a compensation sending key, invented by Sir Charles Bright, and is described by the exhibitors in the following words:—

"It has been found necessary in working long circuits to provide for the irregularities of charge produced by different currents. This was pointed out by Professor Thomson in 1856, and others have, as well as himself, made various contrivances for the purpose. The key now shown is one of a simple form, invented by Sir Charles Bright, for circuits of ordinary length, adapted to the use of the common Morse alphabet by the most ordinary operator. Not intended as affording *perfect* compensation for *very* long circuits, but as an every-day instrument, cheap and simple in regulation, and fit to be put in the hands of any telegraph clerk. On pressing down the key, a lever begins to rise, being governed in its rate of motion by gearing into a small train of wheels controlled by a fan, or any other regulator capable of convenient regulation. If a *stroke* is sent, the lever rises as far as a stop, against which it rests until the signal ceases by the key rising. When it touches, the step part of the battery is cut off, or the whole power may be cut off if desired, thus adding to the pause as well as cutting off part of the stroke sent *into* a line, which is equalised at the distant end by the effects of induction."

This key would accomplish the limited object aimed at by the inventor.

3. *Galvanic Batteries.*

Batteries are, perhaps, worse represented in the Exhibition than any other adjunct of telegraphy. In one form or another Daniell's battery is now chiefly used by the large telegraph companies, although for many other purposes Smee's battery is retained. This latter single fluid battery is, no doubt, a useful form wherever the circuit is seldom closed, and only for short periods at a time; but the simplest experiments show that single fluid batteries will not produce a constant current in a closed circuit for five minutes together, and are, therefore, entirely unsuited for the delicate and accurately adjusted receiving instruments now used.

J. A. Deleuil, Paris, M. (France, 1,421), exhibits a battery known as the "pile Marie Davy," in which sulphate of mercury and carbon electrodes are substituted for the sulphate of copper and copper electrodes of the Daniell's battery. This new form is clean and constant, but it is weaker than the Daniell's cell; it has considerable inherent resistance, and is expensive in the first instance. It is portable, and has been used to some extent in France.

Reid Brothers (United Kingdom, 2,949) exhibit a compact form of Daniell's battery. A glass trough is subdivided into cells by five partitions; this cellular trough is formed of one solid piece of glass. Each cell is again subdivided by a porous plate, cemented at each side and at the bottom between two cheeks. The zinc and copper plates connected in pairs stand astride the glass partitions, and the subdivisions are alternately filled with sulphate of copper and acidulated water. This battery is strong and portable, but the porous plates when worn out can only be removed and replaced with difficulty.

J. Gressler & Co., Berlin, H. M. (Prussia, 1,402), exhibit various sizes and forms of Bunsen's double fluid battery, with strong and simple copper connections. The prices quoted are moderate. The largest size shown had carbon cylinders twelve inches high.

E. Tyer (United Kingdom, 2,977) exhibits a simple and convenient form of Smee's battery, which seems well suited for some purposes. The zinc plates can be readily removed, cleaned, and replaced; they lie in a saucer of mercury, which fulfils the double purpose of maintaining the zinc constantly amalgamated, and of making contact between the zinc and the copper strip which connects the zinc with a platinized silver plate in the next cell. This copper strip is insulated by gutta-percha, except where covered by the mercury.

Very little local action can take place, owing to the thorough and constant amalgamation of the zinc, and, therefore, if the circuit be only occasionally closed for short periods, as when used for train signals or house bells, this battery will remain very constant; but it of course possesses all the unavoidable defects of single fluid batteries. Several thousands of these batteries are at work. The platinized silver plates are found to decay somewhat rapidly in practice.

C. V. Walker, H. M. (United Kingdom, 2,983), exhibits platinized graphite plates to be used instead of the simple graphite plates in Mr. Walker's modification of Smee's battery, which was highly commended in 1851. Mr. Walker states that by platinizing the graphite plates the liberation of the hydrogen gas from their surface is much facilitated, and polarization—one great defect of single fluid batteries—thereby much diminished; the cost of the process is about one halfpenny per plate of the usual size of 7 in. × 3 in. The platinized plates are also said to keep much cleaner than the simple graphite plates.

J. Young, Dalkeith, H. M. (United Kingdom, 2,997), exhibits some very dense and well-made carbon elements of various forms, for batteries, and for the electrodes of electric lamps.

A. Rodler, Nuremberg (Bavaria, 1865), exhibits some well-made carbon elements for galvanic batteries.

(To be continued.)

UNIVERSAL PRIVATE TELEGRAPH COMPANY.

THE Annual General Meeting of the Shareholders of this Company was held at the Society's Offices, 448, Strand, E.C., on Wednesday last, Mr. Alderman Salomons, M.P., in the chair.

The Secretary having read the advertisement calling the meeting, the Chairman next proceeded to affix the Seal of the Company to the List of Shareholders; after which he called upon the Secretary to read the Report, which stated that a year ago the Directors met the Shareholders with a great degree of confidence in the ultimate success of their operations, and of their convictions that capital alone was essential to the development of a remunerative business.

The accounts then circulated had been made up to August 31st, 1862, at which date they exhibited a favourable result, except as regarded the capital, which was clearly insufficient to develope the works commenced. The Directors found it necessary to obtain certain modifications in their agreement with Professor Wheatstone, which he cordially acceded to, and which will tend no less to his benefit than to that of the Shareholders at large. These arrangements having been completed, the Directors proceeded to distribute amongst their friends the remainder of the share capital, for all of which subscriptions were tendered (principally in Glasgow and Manchester), but in deference to the wishes of the Engineer, who was under the impression that Newcastle and Liverpool would desire to take a pecuniary interest in the Company, 827 shares were reserved for that purpose. After encountering considerable obstacles, the Directors have at length secured the consents requisite to the introduction of the Company's wires into Liver-

pool, and as soon as a sufficient rental can be engaged, the works will be proceeded with.

At Newcastle the system has been developed in a very satisfactory manner, and the same may be said with regard to Glasgow, and Scotland generally. At Manchester some progress has been made, but not to that extent which might have been attained had trade flowed in its usual channels. At Belfast the Company's system has recently been introduced with every prospect of remunerative business.

The accounts, as made up to the 31st September last, are presented herewith: the capital account showing a total expenditure of 61,764*l.* 0*s.* 5*d.*; in the revenue account, the balance standing to the credit in the published statement of 31st August, 1862, is brought forward, and the net revenue is now enhanced to 3,812*l.* 7*s.* 7*d.*, out of which the Directors recommend a dividend upon the shares for the past year after the rate of 5 per cent. per annum, which will absorb 1,784*l.* 6*s.* 2*d.*, leaving a reserve of 2,028*l.* 1*s.* 5*d.* The growing importance of the Glasgow district has been felt to require special recognition, and the Board feel so convinced of the value of that branch of the Company's system, that the four Directors who retire by ballot at this period do not offer themselves for re-election, and it is proposed that three of the seats thus rendered vacant shall be filled by gentlemen chosen by the Glasgow Committee. In pursuance of this arrangement, Messrs. John Cameron, James Reid Stewart, and Walter Mackenzie have been selected, and are recommended for election.

Domestic affliction having occasioned the temporary retirement from the Board of Mr. Sam. Mendel, the Directors appointed Mr. Jonathan Mellor in his place. Mr. John Wood also retired in favour of Mr. J. G. T. Child, whose services, it was considered, would make a change for the advantage of the Company, and who was accordingly appointed to fill that vacancy.

Capital Account, *from 7th June*, 1861, *to 31st December*, 1863.

Dr. Expenditure.

	£	s.	d.
Material and erection of wires	38,816	7	11
Instruments and fittings	13,128	6	4
Furniture and fixtures	406	5	6
General charges, including Act of Parliament	4,013	0	8
Concession of Wheatstone's patents, in shares, as per new agreement	5,400	0	0
	£61,764	0	5

Receipts. *Cr.*

	£	s.	d.	£	s.	d.
Share capital:						
216 paid-up Shares, £25 each........	£5,400	0	0			
1,258 Shares, £20 called up	25,160	0	0			
800 Shares, £15 called up	12,000	0	0			
3,635 Shares, £1 called up.	3,635	0	0			
	£46,195	0	0			
Less Arrears of Calls	1,750	0	0			
				44 445	0	0
Calls in Advance............				13,865	0	0
Balance (see General Balance Sheet)				3,454	0	5
				£61,764	0	5

Revenue Account, *from 1st September*, 1862, *to 31st December*, 1863.

	£	s.	d.
Line Expenses and Maintenance..................	1,668	12	3
Salaries, Rent, and Office Expenses	1,478	2	7
Interest Account, including Interest on Calls in Advance	554	3	11
Balance (see General Balance Sheet)	3,812	7	7
	£7,513	6	4

	£	s.	d.
Gross Balance, 31st August, 1862	1,356	8	3
Rentals of Wires and Instruments	6,156	10	7
Transfer Fees	0	7	6
	£7,513	6	4

General Balance Sheet, 31*st December*, 1863.

Assets.

	£	s.	d.	£	s.	d.
Bankers' Current Account .	£3,015	14	11			
Cash in hands of Officers....	186	18	5			
Rentals outstanding	1,623	17	4			
				4,826	10	8
Stores on hand				1,024	1	0
Capital Account (Balance as above)				3,454	0	5
				£9,304	12	1

Liabilities.

	£	s.	d.
Sundry Creditors: *Less* amounts due to the Company	5,065	18	11
Sundry Shareholders: For Interest on Calls in Advance	426	5	7
Revenue Account (Balance as above)	3,812	7	7
	£9,304	12	1

23rd February, 1864.

The Chairman then said that he was glad to see so many present on that occasion. There had been no meeting of the Shareholders since that time last year, and though at that time their Company looked in a good condition on paper, they found that capital was wanted in order to obtain success, and he was glad to say that now they had capital enough for all reasonable purposes. They had an excellent working committee, who looked well after the interests of the Company. They had introduced their system into Liverpool, and it might have been supposed that there they would not have met with any difficulties, but impediments were met with in everything, however useful it might be, and they had found in this case that they were not free from all the incidents connected with the introduction of a new company. For some time they laboured under the disadvantage arising from the want of capital, but that was not the case now. Considerable exertions had been made by the members of the Glasgow Committee, for which district a number of shares had been reserved, all the rest having been disposed of. The directors had well considered what was right to be done for the prosperity of the company, and some had run considerable risk to bring the company to be a success; for it was found that, without having fresh capital subscribed for, they could not make it productive. He (the Chairman) was glad to inform them that the affairs of the company were now in a prosperous condition, and that the directors had agreed to recommend a dividend on the shares at the rate of 5 per cent. per annum, and that, after deducting 500*l.* for the maintenance fund, they would have a balance of 1,600*l.* due for rentals. Their system was working well in Glasgow, as well as in other parts of Scotland, and he believed that the results would be most satisfactory. There had been some alteration made in the board of directors, which would render it more efficient; the four directors who retire by ballot on the present occasion, not offering themselves for re-election, three to be proposed in their stead, representing the Glasgow interest. That being the present position, and the future prospects of the company, he had now only to move the adoption of the report and the statement of accounts, with the payment of a dividend, at the rate of 5 per cent. per annum, which was carried unanimously.

The Chairman next proposed that Mr. John Cameron, Mr. James Reid Stewart, Mr. Walter Mackenzie, and Mr. J. G. T. Child be directors, in the place of those gentlemen who retired by ballot on the present occasion. It would be found by that proposition, that the directors had been desirous of having Glasgow represented on that board, and they asked the sanction of the shareholders thereto; for it was considered that Liverpool and Glasgow should be represented at the board, according to the capital subscribed for by those towns. There was still a large field in London which might be worked up, and yield an excellent return to the company. Mr. Sam. Mendel, to whom the company owed a great deal, from the capital and influence he had brought to bear on behalf of the company, resigned his seat at the board, entirely on account of indisposition, finding that his health precluded him from attending to the duties as he wished, and he hoped that those gentlemen who would come on the board would be found a source of strength and influence for the good of the company. The motion having been put, was carried unanimously.

Messrs. Alison & Waddell were next re-elected auditors for the year ensuing.

Mr. J. Mellor then proposed "that the thanks of the shareholders be given to the chairman, Mr. Alderman Salomons, M.P., for presiding on the occasion, and for the interest he had taken in the general welfare of the company.

Mr. S. Gregson, M.P., seconded the proposition, remarking that it was a source of astonishment to him that their Chairman was able, with his numerous engagements, to devote so much valuable time to the interests of the company; he therefore felt that he deserved their best thanks.

The motion having been put, was carried with acclamation. The Chairman in acknowledging the compliment took occasion to say, that he would repeat what he said last year, that he had found the greatest assistance from their excellent Secretary, Mr. Hertslet, and he did not know any company where the directors had a more zealous and efficient one. He could not say all in his presence which he deserved, but he felt at liberty to say just so much; for a great deal of the prosperity of the company in London was due to his gentlemanly conduct.

The business of the meeting then terminated.

BRITISH AND IRISH MAGNETIC TELEGRAPH COMPANY (LIMITED).

Mr. Langton (in the absence of Mr. J. C. Ewart, M.P.) presided at the annual meeting of the shareholders of this company, which was held in the Clarendon Rooms, Liverpool, on Wednesday, the 24th instant.

The report and accounts having been taken as read, the Chairman congratulated the shareholders upon the success which had attended their operations during the past year. They had suffered increased competition, and had to work in certain parts of the kingdom at reduced rates. In addition to this, both of their cables between England and Ireland became partially useless in the autumn, and so stormy was the weather at that time, that the replacement of the cables cost nearly 6,000*l.*; the operations—which under favourable circumstances would only have occupied a week—having extended over three months. Still, in spite of this, they were not only able to place the whole of this charge upon the year's revenue, but to declare a dividend of 5 per cent. upon the half-year, making the average dividend on the year 4¾ per cent. against 4½ per cent. on the previous year.

A variety of resolutions of a formal character were passed unanimously, and the retiring directors and auditors were all re-elected.

The Chairman also alluded in feeling terms to the serious illness of the secretary, Mr. E. B. Bright, and expressed a hope that the company would soon again have the benefit of his valuable services.

The proceedings terminated with an unusually hearty vote of thanks to the chairman.

COLONIAL TELEGRAPHY.

THE ELECTRIC TELEGRAPH AT THE CAPE.

By far the most important event of the month, regarded with a view to its ultimate effect upon the development of the resources of the colony and its political institutions, has been the public opening of the electric telegraph between Cape Town and Graham's Town. The formal opening took place on Friday, the 8th proximo, when, by invitation from Mr. Wollaston, the general superintendent of the company, his Excellency the Governor, Lady Wodehouse, and suite, the members of the Executive, the Judges, the heads of departments, and a numerous company of ladies and gentlemen assembled in the large hall of the Commercial Exchange, which had been temporarily connected with the telegraph. The instrument was placed upon a table in the centre of the room, around which the company gathered to listen to the explanations, and witness the illustrations of its action given by Mr. Wollaston. The system of telegraphy employed is Morse's improved by the contractors, Messrs. Siemens, Halske, & Company. Congratulatory messages on the completion of the line were exchanged between his Excellency the Governor and the Municipalities of Mossel Bay, Port Elizabeth, and Graham's Town, and other persons. On the following Monday the line was opened for the use of the public, and has since been fully employed. The amount of business far exceeds expectation. The scale of charges adopted is very moderate. The line is most substantially constructed, and messages between Cape Town and Graham's Town are transmitted the entire distance of six hundred miles without the necessity of repetition. Sir Thomas Maclear, the Astronomer Royal, bears high testimony to the character of the line, in the following letter to the Editor of the *Cape Town Argus*:—

Sir,—It is suspected that the Graham's Town authorities missed the complimentary message from his Excellency the Governor in consequence of not allowing for the difference in longitude between Graham's Town and Cape Town.

The meridian of Graham's Town is thirty-one minutes fifty-nine seconds, or, in round numbers, thirty-two minutes east of the Royal Observatory; therefore, the hands of a clock adjusted to Graham's Town local time are thirty-two minutes farther advanced on its dial at any given instant than the hands of the Observatory dial. For example, one o'clock Observatory time is coincident with thirty-two minutes past one Graham's Town time.

I was not near the message instrument while the operations were going on, but I am told that the messages were forwarded to the localities in the order of increasing distance—the method adopted at the great telegraph exhibition at Manchester some three years ago.

Suppose his Excellency's message to have been transmitted at half-past one o'clock, the corresponding Graham's Town time would be two minutes after two o'clock—late enough for the exercise of patience on an occasion so interesting, if the longitude was overlooked, or for suspecting a mishap to the wire.

The following longitudes of stations on the line are derived, save one, from Captain Bailey's geodetic operation:—

	East of the Royal Observatory.	
Mossel Bay	14 minutes	31 seconds.
George	15 „	57 „
Uitenhage	27 „	41 „
Port Elizabeth	28 „	35 „
Graham's Town	32 „	0 „

For any given instant the local time at each of these stations appears to be *later* than the time at the Observatory by the numbers here recorded.

For example, suppose the instant of the one o'clock time-ball signal given from the Lion's Rump, to be transmitted along the line, the clock at Mossel Bay, if correct, would indicate one hour fourteen minutes thirty-one seconds, and so on for the others. In England little attention is paid to local time. Greenwich time is signalled throughout the kingdom, by which arithmetic and uncertainty are got rid of.

The longitude of Swellendam has not yet been investigated.

I shall now offer a few remarks relative to the character of the line of telegraph which has been established—which I would have stated at the meeting on Friday, if circumstances had afforded a fitting opportunity—premising that my intimacy with Mr. Wollaston is sufficiently slender to relieve me from bias, were I capable of indulging it on a question of public service, which doubtless he will understand.

When the contract was being made with Mr. Pickering it was urged, on the part of Government, that the line wire should be number 6, instead of number 8, because its transmitting power, irrespective of the advantage of its strength, would be in the ratio of 1·4 to 1—viz., nearly one half greater than number 8. This was refused on the part of the contractor, and instead "equal to the best telegraphs in England" was introduced. Mr. Wollaston left for England the day after the contract was signed.

Little was heard of the telegraph contract for many months, and that little was not over encouraging. In the meantime, I rendered all the advice and assistance at my command in support of the badly established segment between Port Elizabeth and Graham's Town, and to its still more rickety cousin between Cape Town and Simon's Town.

At length a company was got up in London to carry out the contract. Mr. Wollaston returned to the Cape, accompanied, to my astonishment, by Mr. Hoeltzer, of the house of Siemens & Co., one of, if not the most celebrated scientific telegraph engineering firms of the day. No. 6 wire was to be adopted, and to be carried by their iron-clad insulators.

To whom the credit is due of engaging that firm I know not, nor is it my business to inquire. I only know that it was sound policy to do so, because Siemens & Co. have a character to support, and would prefer incurring a loss to damaging it by flimsy work.

Experiment has proved the wisdom of the policy. The line is established, and with fifteen cells only of Daniell's constant battery, a through message has been sent from Cape Town to Graham's Town.

(By a through message is meant with the sections of the line joined up, without an intermediate relay.)

Mr. Hoeltzer is my authority for this statement. To work a registering instrument at the distance of 600 miles with only fifteen cells is a very strong proof of a well-insulated wire, notwithstanding the advantage of a dry warm atmosphere. To deflect a delicately-suspended needle is another matter.

With respect to the quality of the supporting poles beyond the immediate neighbourhood of Cape Town I know nothing; those I have seen are very good. It is a pity that iron poles were not available; they are far cheaper than wood in the long run.

Upon the whole, in my humble opinion, the colony has made a good bargain.—I am, &c., THOMAS MACLEAR.

Royal Observatory, Jan. 11, 1864.

TELEGRAPHY IN NORTH BRITISH AMERICA.—The first step towards opening up that splendid country is obviously the construction of a line of telegraph from Fort Garry westward—an enterprise rendered the more certain of success from the fact that a line of telegraph is steadily advancing from Europe to the East to meet it, and which, in a but comparatively short time, will make it possible to telegraph from London to Fort Garry, by way of Siberia and British Columbia. The connection between Fort Garry and Montreal is essentially a Canadian question, and can be dealt with in no other way—the Hudson's Bay Company having no right to the land through which such connection must be made. This matter was brought under the notice of Parliament last session by papers laid before the House by the Government. From them it appeared that negotiations had taken place with reference to an annual subsidy from Canada, in conjunction with British Columbia and Vancouver's Island, to secure a through line of telegraph and a waggon road between the two oceans. The two last named colonies have, it is stated, agreed to their share of the subsidies, but at present Canada has not. Canada can, therefore, it would seem, secure a telegraphic communication with Fort Garry whenever she likes, either by an annual subsidy to a private company or by making the telegraph line herself. This must of course dispose of any fear, as has been suggested, that the proposed line of telegraph through the Hudson's Bay territory is to be made subservient to American interests. The American system of telegraph lines is now in operation nearly 50 miles north of St. Paul and some 350 miles from the British line at or near Pembina, which is only 50 miles from Fort Garry. That the Americans will carry their line of telegraph to Pembina it would be absurd to doubt, or that they will seek a connection there with any line that may be made westward from Fort Garry. And why should they not? If a telegraph is completed between Europe and Fort Garry, the practical eastern terminus of the Hudson's Bay Company's control, would it not be absolutely essential that it should be connected with the lines in the United States, and is it not desirable that connection should be made as far east as possible? A line of telegraph already exists between New York and San Francisco. It will doubtless seek to connect with any line coming from Europe by way of Behring's Straits by a junction on the Pacific coast. How much better for British interests that that such connection should be made at Fort Garry instead. A line of telegraph through the Saskatchewan valleys, with its posts every 30 or 40 miles, selected with care and judgment, and forming the nucleus of settlements, will very soon force on the question of roads and railways through the country. A waggon road, indeed, already exists from Fort Garry to the base of the Rocky Mountains—a road perfectly well defined, and which, before the American war broke out, was travelled by upwards of 300 persons in one spring. The construction of a line of railway will in time follow the telegraph. It is, perhaps, not generally known that the only practicable road from the east to the west on this continent is through British territory. The United States have reached the limit of the cultivable land in their territory; west of it lies a great rainless desert, bare of vegetation, destitute of timber, with a soil as dry as sand, and in some parts of which rain has not fallen for 22 months.

OVERLAND TELEGRAPH.—We are glad to find that steps are being taken to open negotiations with the California State Telegraph Company to extend their line to Victoria from Portland, to which point it is to be finished in a few weeks, according to our latest Oregon advices. We understand that J. J. Southgate, Esq., has replied to the letter addressed to him by Mr. Carpentier, President of the State Telegraph Company, encouraging him in his proposition, and inviting him to come to Victoria to lay his plans before the House of Assembly. We earnestly hope that his advances may be met in the most cordial manner by the House and the community at large, and that every endeavour may be used to secure so great a boon as the proposed scheme offers.

CORRESPONDENCE.

ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I cannot but believe that many of the shareholders of the Electric and International Telegraph Company, who, like myself, were absent from the last half-yearly meeting, must, upon reading the evidently faithful account of that meeting which appeared in your journal, feel somewhat ashamed of the proceedings of those who were present upon that occasion.

I do not allude to the mere fact of their refusal to carry out the directors' proposition of granting an annuity to Mr. Fourdrinier, because that is a question on which, notwithstanding that there are plenty of precedents for such an arrangement, many persons may raise, as several of the speakers did raise, valid objections; but, sir, I do think that many, and especially the older shareholders, will feel with me, that in past years, when there was quite as much legitimate freedom of discussion at the meetings of the company as exists now, such a personal attack as that made by Mr. Reid, upon the late secretary, would never have been permitted, and I confess that I am astonished that neither the chairman or the meeting interfered to stop it. Of one thing I feel sure, that had such an attempt been made to lower the reputation of the late secretary in the estimation of those whom he has so faithfully and zealously served, when the late Mr. Ricardo filled the chair, he would either have stopped it, as being irrelevant to the question, or he would have answered it in such a manner as would, probably, have awakened in Mr. Reid what little remorse he is capable of feeling. I have been told that Mr. Reid has been heard more than once to wish for the "old chairman" back again. I presume, therefore, that in common with many others, he held a high opinion of Mr. Ricardo's judgment. Does he know, as I do, that in the estimation of that gentleman, to whom I am told all the officers of the company are deeply attached, no one member of the company's staff occupied a higher position, for zeal, industry, and integrity, than did Mr. Fourdrinier? What bearing upon the proposal of the directors had the tales of Mr. Reid, as to the origin of Mr. Fourdrinier's connection with the company, even though he had proved, as he utterly failed to do, anything of which that gentleman need be ashamed? What matter was it to the meeting of January, 1864, who first introduced that gentleman to the company fifteen years ago, provided he has filled his appointment, as he undeniably has during that long period, to the entire satisfaction of his directors, whose esteem and friendship he enjoyed to the last. As to Mr. Reid's extravagantly absurd assertions "that any stockbroker's clerk would have performed the duties of secretary for £100 per annum, and would have performed them better than Mr. Fourdrinier," they need little comment; for I think that any one, who has been brought much into contact with Mr. Reid, will agree with me, that of all persons in the world, he is about the least fitted to form a judgment of what the duties are of a secretary to an important public company, or of the manner in which they should be performed. There are, however, very few shareholders who have had the same opportunity that I have had of knowing that Mr. Fourdrinier's labours for the company did not, like those of the other officers, end with office hours, but that even his leisure hours, if they may be so called, were largely devoted to the study of matters in which the company's interests were involved, and that, in fact, the advancement and prosperity of the company was the all-absorbing subject of his time and thought. With respect to the alleged severity towards the clerks, and the "toadyism" towards the directors, I do not believe that Mr. Reid could ever have been in a position to know much, if anything, of the secretary's behaviour towards the one or the other; but this I do believe, sir, that Mr. Bidder, the only one of the directors who was man enough to stand up on behalf of their late officer, hit the right nail on the head when he stated it as his belief that Mr. Reid's unworthy attack was dictated by personal animosity.

It is not an unusual thing, sir, for a zealous officer such as Mr. Fourdrinier is admitted by every one but Mr. Reid to have been, to interfere materially with the interests and the gains of contractors. It is quite possible that Mr. Fourdrinier's predecessor, who appears to have enjoyed a so much higher position in Mr. Reid's estimation, was not so careful of the interests of the company in respect to contractors' profits, and that with the change of secretary Mr. Reid's successful career as a telegraph contractor was shortly brought to a close. If this be so, have we not a key to the violent animosity displayed by the ex-contractor towards the ex-secretary. So much, sir, for the attack and the quarter from whence it sprang; but what am I to say of the ungenerous absence of any defence (Mr. Bidder's remarks always excepted) on the part of the Board, of the gentleman upon whom the chairman had just before been passing an eulogium? Have those gentlemen lost all their spirit, that they tamely allow a few personal remarks from one of their old contractors to negative a proposition which it is but fair towards them to suppose they did not lay before the meeting until it had received their full and serious attention? Would such a thing have happened in the old times? Sir, I think not; and I feel sure that if the directors of the telegraph company wish their officers to work with that hearty goodwill and industry to which they have borne such willing testimony in the case of Mr. Fourdrinier, they must in future show a little more generosity than they have done in this instance in upholding the reputation of those officers against such an attack as that of Mr. Reid, and a little more determination and energy in insisting upon their recommendations being carried out, at all events in spirit if not to the letter, where the welfare of their staff is concerned.

ONE WHO WAS UNABLE TO ATTEND THE MEETING.

Paris, Feb. 17, 1864.

THE PNEUMATIC APPARATUS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Mr. France states that Mr. Jones called on him, "towards the end of 1860, about these very relays." If this is intended to convey any impression at all it must be this, that Mr. France saw Mr. Jones relative to the construction and working out of these relays, as no other impression would be of any value to Mr. France's argument.

Mr. Jones has authorised me to state positively as to this, the first pneumatic arrangement ever made, that not alone did he receive no instructions whatever from Mr. France, but that he never saw that gentleman until long after the complete instrument had been delivered to me at the Submarine Telegraph Company's office, nor did he ever see him as to the mode of constructing or working out any of these arrangements.

Mr. Jones further informs me that he introduced himself again to Mr. France, in 1862, as the maker of Andrews' pneumatic arrangement, and that he had always understood this to be my invention.

Mr. France further says, "Why does not Mr. Guy furnish the account?—this would settle, once for all, whether any were made before my return from the Mediterranean, in February, 1860." This is a ghost raised by Mr. France for the purpose of being slain by him. Throughout this discussion it has never been stated that these arrangements were made before Mr. France's return from the Mediterranean. What was distinctly said was, that they were "mooted and proposed," and it was also expressly said that they were long in hand.

Mr. France sends a letter written him by Mr. Shaw after I left the company, in which he uses the words "your pump-relays." Mr. Shaw was stationed at Cromer—just 126 miles from the metropolis—during the whole of this period, and wrote from Cromer; he could, therefore, know positively nothing as to who invented the apparatus.

Mr. France writes, "Mr. Harwood's letter plainly says some of these apparatus (pumps, namely,) were at work when he took charge at Cromer." I refer your readers to Mr. Harwood's letter.

Mr. France occupies the extraordinary position of claiming an invention that he had nothing to do with the planning, or ordering, or working out of, and that he never saw until it reached the Submarine office a complete instrument.

Mr. France is now where he was at first, without a scrap of positive evidence connecting him with the invention, and with his mere statements, wherever necessary, confuted.

I believe that I could have closed this matter earlier, but on applying to the Submarine Company for permission to inspect the books and letters of my department during the period in question, I was informed that the keys of the iron safe, and boxes containing them, were lost, or mislaid, and as they were expected to be found, there was an objection to break open these things; I have, therefore, only been able to reply to Mr. France from memory.

I am, Sir, your obedient servant,

W. ANDREWS.

Melbourne Cottage, North Brixton,
Feb. 25, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Both Mr. Andrews and Mr. France are very old and good friends of mine, and it is therefore with great regret that I find my name mentioned in their correspondence on the pneumatic relay. Mr. France, I believe, connected the first pneumatic relay up at Cromer in the early part of *October*, 1860; and from this circumstance I must have drawn the inference that he was connected with the invention, as I cannot remember any direct information on the matter until after I had resigned the Submarine Company's service, when, in a conversation with Mr. Andrews on his various inventions and apparatus, I mentioned Mr. F.'s name in connection with the pump relay. Mr. Andrews at once and most emphatically declaimed against Mr. France being the inventor; and to establish his own claims most decisively, Mr. Andrews had many preliminary drawings and plans.

This conversation took place before it was proposed to adopt the pneumatic relay on the Persian Gulf lines, and *many months* before the correspondence in the "Telegraphic Journal."

I regret to find that the present clerk in charge at Cromer speaks so disparagingly of the apparatus, described in the correspondence as No. 3, as both Mr. France and myself reported very favourably of it; and I have no doubt, that but for the simplicity and less cost of the pneumatic relay, it (No. 3) would still be at work on the Submarine Company's lines.

I am, Sir, yours very obediently,

WM. H. SHAW.

Newcastle-on-Tyne, Feb. 23rd, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I think your readers will agree with me that Mr. France's statements require no further refutation than is contained in his own letters of the 6th and 20th instants. In the former he says, in reply to my statement that he did not see the workmen about the pneumatic relays, "When I went to Aldersgate-street I was invariably addressed direct to the workmen"—leading your readers to infer that my statement was untrue; but when, in my letter of the 13th, I proved that what I there stated was correct, he suddenly turns round and says, "Oh, I recollect now, the first *relays* were not made at the factory, but by a workman off the premises, and the reason I now know his name is that he (the workman namely) called upon me, in company with Mr. Guy, at the end of 1860, about these very relays."

I have only to say as to this, that Mr. France did not see Mr. Jones until long after the first pneumatic arrangement was completed and delivered.

If Mr. France refers to his order, or the accounts of the company, he will find that Mr. Andrews ordered seven of these pump arrangements, and that after Mr. Andrews left he (Mr. France) ordered four more—the last of which was delivered in March, 1861. My assertion, therefore, is perfectly correct.

I am, Sir, your obedient servant,

Windsor-terrace, City-road, 25th February, 1864. G. GUY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have made inquiries, and find, in confirmation of my letter of the 30th ult., that three of Mr. Andrews' double stream Morse instruments were mounted at Heligoland on the 22nd December, 1860; three others having been mounted at Flensburg about a fortnight previous—therefore subsequent to the 27th October, when the first pump relay was completed.

I am, Sir, your obedient servant,

Cromer, Feb. 23rd., 1864. F. HARWOOD.

THE TELEGRAPH CLERKS' PROVIDENT FUND.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I was much grieved when I read in your last number that, at a meeting of the *employés* of the Magnetic Telegraph Company, after considerable discussion, a resolution was passed to the following effect, viz.:—"After carefully investigating the scales of payment, remuneration, and the rules, regulations, &c., of the 'Telegraph Clerks' Provident Fund,' this meeting is of opinion that the benefits to be derived therefrom are not adequate to those offered by other societies of a like nature, and that the numerous technicalities and requisitions introduced into the said rules debar the majority of telegraph clerks from becoming members." Having read carefully the rules, regulations, &c., I cannot conceive what kind of arguments could have induced those present at the meeting to arrive at the conclusions they appear to have done. One might have reasonably expected that a society, patronised by some of the leading men of the day, and by many of the most influential directors of telegraph companies, would at least have paid attention to its rules, regulations, &c., so as to confer the greatest possible benefit upon those for whom the fund was instituted. It is to be feared that this unfortunate resolution on the part of the meeting is only another instance of the senseless jealousy and rivalry which exists between the *employés* of the various companies. Every attempt to bring them together to co-operate in some action for mutual advantage has failed. It is all *repulsion* without *attraction* or adhesion. Why is it? I believe the question has been fully answered by your correspondent, who signs himself as "One of the Least," in your last number.

Yours, &c.,

A SHAREHOLDER.

SELF-HELP.

To the Editor of the TELEGRAPHIC JOURNAL.

Dear Sir,—Permit me, through the medium of your valuable paper, to reply, in a brief and concise manner, to a letter in your last week's number, signed "One of the Least."

I read with pleasure the remarks, and also the scheme for establishing a *recreation* club for the telegraph *employés* in general. I firmly believe such a club could be established, but it requires the assistance and support of the directors of the various telegraph companies. I regret that hitherto a friendly feeling between the *employés* of the telegraph companies has not manifested itself, but the time for improvement has arrived. The clerks of each company have tried to establish an institution for themselves, and by doing so have failed.

The success of such an undertaking depends solely on strength and union, and I trust the time is not far distant that a similar club will be established. I feel confident that the directors of the various companies would assist their *employés*, and the scientific men connected with telegraphy would enhance the value of the institution by giving lectures occasionally, by which the members would become better acquainted with the noble science of telegraphy, and would feel more interested in the performance of their duties.

Let us, therefore, hope that, with the aid of our friend, Mr. Editor, the scheme in contemplation may be crowned with success.

Feb. 23rd., 1864. A FRIEND.

TELEGRAPHIC FEATS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have read with much interest the paragraphs and correspondence in your journal on the subject of the speed of the respective instruments used by the existing telegraph companies. Perhaps my opinions as an old telegraphist, as a manipulator of considerable experience and practice, and I may add (without being egotistical) of speed and general ability in this department, will assist in the solution of the question of their merits. A good and intelligent manipulator is the best judge of the powers of the instrument he works, and if he is capable of working those used by the two large companies, his judgment of their merits is the more trustworthy and correct. Others who do not understand the ramifications of transmitting business are liable to be misled by appearances, and to be blinded to real facts by their enthusiasm and admiration. They are told of "feats," which, to an old clerk, are of hourly occurrence, and at which he quietly smiles. In fact, I agree with the bell clerks at Glasgow, that the speed of transmission of the Queen's speech was slow, excepting that of the Magnetic Company (forty-eight words per minute).

The double needle requires two wires. The difficulty of watching and of catching the usually feeble and spasmodic clicks of two needles necessitates great care, great practice, and a diminution of speed; the handles by which they are worked are cumbersome, and soon tire the arm of the clerk. There is the possibility of a difference of signal-power on the separate needles, according to insulation, manufacture, &c. They are a delicate instrument, and a writer is required. On the other hand, they are advantageous, inasmuch only as in case of stoppage of one wire the other can be worked (if it be preserved) by the Morse code. A clerk on the double needle can send at a great speed, but the reader cannot follow the needles above a maximum of about thirty-eight words per minute. The single needle, from the nature of its construction and code, is very slow and uncertain, its maximum speed being about fifteen words per minute.

The Morse instrument is most decidedly the king of instruments, taking into consideration all its properties of application, although its speed is poor comparatively. It allows clerks of different nations and tongues to converse in a language (so to speak) of itself—telegraphic and universal. It will work long lengths of wire, and is peculiarly adapted to submarine telegraphy. It records every stroke made.

There is, however, one instrument which, in my opinion, for home work surpasses all these. I refer to Mr. Bright's bell used by the Magnetic Company. Often I have been surprised to see so little said of it. Very few really understand its merits. The others have all, more or less, and at one time or another, received their meed of praise and attention; yet this beautiful and useful instrument is unnoticed. I leave it to others more competent than myself to explain the principle and nature of its construction: with its powers of working I am well acquainted. By means of the two bells the ears perform the office of the eyes with the needle systems, and the eyes are at liberty to attend to the "caligraphy." Whilst hearing the signals the clerk can write down the despatch; and so firm and distinct are the beats of the hammers upon the bells, that there is little fear of error. The attention of stations is sooner gained; the confidence is greater; signals, by means of the relay, are stronger; the services and wages of a writer are dispensed with; the speed is greater; the work easier, and less painful; the eyes are not taxed injuriously; many little things can be attended to whilst receiving.

"An Old Double Needle and Morse Clerk" asks, "Will the bell clerk undertake to say he never feels doubtful respecting the correctness of a message he may have received?"

An "Old Bell Clerk," in return, asks him, "Does he not sometimes gaze in bewilderment at the confused mass of dots and bars which some blundering clerk has sent on his *recorded copy?* Is not the receiving slip, or recorder, subject to the same irregularities, messes, and mistakes which the sender may make by the impression of his key, &c.? and, whilst the Bell clerk by *one tap of his key* can stop and have a fault corrected in an instant of time, the poor recorder has to 'finish his yarn' before he can do it!"

The Bell affords facilities for quick exchanges of questions and answers and ideas. Correction or repetition is obtained with *one tap* of the key by expert clerks. Conversation and quick stoppage and renewal of work is scarcely possible with the Morse. The maximum of speed with the bell instrument is about 50 words, of average length, per minute—35 and 40 words is common throughout the day and night on busy circuits in any of the Magnetic Company's offices; and one clerk, I assure you, often takes two or three columns of matter, writing for himself, and *revising as he goes on*, sending copy direct to news room or paper, decent and respectable, at 30 and 35 words per minute.

The needle instrument, used by the Magnetic Company, on the principle of which the bell is an improvement, is also a simple, useful, and speedy instrument, superior to the single and double needles mentioned before.

Your correspondent "P. D. Maxwell," and others who have taken part in this discourse, as well all as your readers generally, may, perhaps, find the above interesting—perhaps instructive; and, if this be the case, I am content that I have not wasted your space in giving a close and *impartial* examination into the subject, and which is the result of experience and labour in telegraphic concerns. W. H. N.

Stockton, Feb. 23rd., 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—As you have already given publicity to several communications relative to the degree of speed with which intelligence can be transmitted by different telegraph companies using different apparatus, I hope you will be kind enough to allow me space for a few remarks upon the same subject. I am a practical telegraph clerk of some years' experience in single and double needle and Morse working, obtained in the services of the Electric and International and the United Kingdom Telegraph Companies. Never having been in the Magnetic Company, I cannot speak positively of either their instruments or working; but I quite agree with your remark applied to a performance of one of their clerks, who is reported to have received the Queen's speech (writing for himself) at the rate of forty-eight words and a fraction of a word per minute, which certainly is, in my humble opinion, "truly marvellous;" an opinion I am inclined to think that will be shared by a large majority of telegraph clerks. With regard to quick working, it is really more a question of clerks than instruments. And the transmission of speeches is by no means a fair or full test of the merits of either so far as general working and utility is concerned, as the rate of speed attained in transmitting a speech would offer a wide contrast to the ordinary rate at which messages and general telegraph work is transmitted, no matter what instruments or clerks be employed, for this reason: a speech is a straightforward piece of work for the telegraph clerk; it is very readily understood, and generally of such a character that any doubtful word can be easily determined or supplied by the sense of the matter (a very great boon to needle or bell clerks), in addition to which it admits of much abbreviation. With ordinary messages it is altogether different. In these the telegraph clerk has to encounter all the technical terms used in the various trades and professsions, names of persons, ships, places, &c. (many of which are foreign), and a host of other matters, some of which are quite unintelligible to the telegraph clerk, as, for instance, messages sent (as many are daily) in a code known only to their senders and receivers themselves; and it is in dealing with this general business that the Morse proves itself so superior to all other instruments; and it is here also that the needle and bell instruments fail to keep up even a fair or proportionate speed with their speech working, &c.; and I will undertake to say that the bell clerk reported to have performed the "truly marvellous" feat of receiving and writing for himself forty-eight words and a fraction per minute, would find a great (and I believe an insurmountable) difficulty in reaching an average of half forty-eight words per minute if occupied with such work as I have just alluded to. My intention, however, is not so much to say anything against the bell instruments as it is to say something for the Morse, which for accuracy and general utility is undoubtedly and deservedly the first and best instrument of the day, for no matter what language or form is employed by the telegraphing community, it is all the same when written in Morse, and a tangible record is left for future reference if required. I do not mean to say that English clerks not understanding French or German, for instance, could take messages in those languages on Morse as quickly as if they were in English, but I do mean to say that the Morse would in such a case possess an immense and obvious advantage over either bell or needle instruments. The fastest Morse working I have seen has been in the United Kingdom Telegraph Company, whose form of apparatus is a great improvement upon that used by the Electric and International Telegraph Company—when I left at least—(so far as quick working is concerned I can speak positively); as the manipulating key in the latter company used to require about six times the "play" those used by the United Company do, and as a man can walk a short distance quicker than a long one, so a telegraph clerk can mark quicker with a key of "short play" than with one of "long play."

Yours obediently,

Newcastle-on-Tyne, Feb. 20th, 1864. R. A.

AERIAL WORK.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your impression of last week, referring to our aerial work in Huddersfield, you make an inaccurate statement, or rather leave your readers to believe that a somewhat serious expense has been incurred by my company through the accident to the contractor's tackle in fixing bracket to chimney. The entire cost of making good all such damages did not exceed £6.

I am Sir, yours very truly,

Pro JOHN DOHERTY, District Superintendent.

The United Kingdom Electric Telegraph Company (Limited),

Manchester, Feb. 23rd., 1864.

IMPORTS OF GUTTA PERCHA.—The quantities imported into the United Kingdom have fallen off within the last three years. In 1860 they were 21,321 cwts.; in 1861, not more than 19,749 cwts.; and in 1862, 18,284 cwts.—so that, comparing the latter with the former year, a decrease appears of 3,037 cwts., or about 14 per cent. British India contributed in 1862 four-fifths of the total supply. Holland furnished 1,736 cwts.; Borneo 1,163 cwts.; and all other places made up an additional sum of 858 cwts. The total value of the imports in 1861 was £130,602; in 1862, with a decreased supply of 1,465 cwts., it advanced to £195,399. The average price in the former year was £6 12s. 3d. per cwt., whereas in 1862 it ranged from £10 8s. 10d. to £11 1s. 2d. per cwt.

TELEGRAPHIC NEWS.

THE *Malta Times*, of the 11th of February, publishes the following information:—"The Otrante and Avlona Telegraph Cable.—We understand that telegraphic information has been received in Malta from the Chief Inspector of the Italian Telegraph Administration that the vessel with the cable is now lying at Brindisi, and is only waiting for fine weather to commence the submersion of the cable."

THE OTRANTE AND AVLONA CABLE.—This expedition, in charge of Mr. G. Henley, arrived at Brindisi on or about the 26th of January last. After having been detained in that port sixteen days by stress of weather, they proceeded to lay the cable from Otrante, but the weather became so boisterous, causing the ship to drift, that before the point on the other side had been reached the whole of the cable was found to be submerged. The contractors intend to complete the undertaking so soon as the weather moderates.

TELEGRAPH TO INDIA.—The Convention between the English and Turkish Governments, relative to the operation of the new telegraph to India, which is to pass through the Ottoman dominions, was signed on the 17th instant.

INDIAN TELEGRAPHS.—The progress of the great lines of railway in British India has naturally been followed by the extension of the electric telegraph, as has been the case at home. We understand that a contract has been entered into by Messrs. W. M. Warden & Co., of Great George-street, Westminster, for the construction of a line of telegraph on the Jubalpore branch of the East Indian Railway Company, the whole length being 250 miles. The poles, wires, insulators, &c., are of the best materials and improved forms. The batteries to be employed are Muirhead's sulphate, which have already proved themselves exceedingly well adapted for hot climates, being universally adopted on the telegraph lines in India.

THE PACIFIC TELEGRAPH COMPANY.—This company's line is 1,700 miles in length, and extends from Chicago to Salt Lake city, Utah territory, where it is connected with the Californian lines. The line is divided into three circuits: the first, extending from Chicago to Omaha city, Nebraska territory, is 600 miles in length; the second, from Omaha city to Fort Laramie, is also 600 miles long; and the third, from Fort Laramie to Salt Lake city, is 500 miles long. The whole line is constructed with No. 9 iron wire and cedar posts, set 16 rods apart, and is one of the best working circuits in the United States. On the first section of the line 60 grove cells are used as line battery, and on the second and third sections 50 cells. Chicago works *direct* with Salt Lake city by means of repeaters (relays) at the two intermediate stations; it also occasionally works direct with San Francisco, which is 900 miles west of Salt Lake city—bringing the total length in direct communication to 2,600 miles. The number of operators employed are—two at Chicago, three at Omaha city, two at Fort Laramie, and four at Salt Lake city; all which are first-rate workers on the instrument in use—the Morse, read by *sound*, with the American alphabet, which is shorter than the European one.—(*Special Correspondent.*)

MALTA AND ALEXANDRIA CABLE.—By the arrival of the last mail from Malta, we are placed in possession of the following intelligence:—Her Majesty's screw corvette *Cossack*, 20, Capt. W. R. Roland, was under orders to leave on the 16th instant for Corfu. It was understood that she was to take up Major Schaw, an officer of the Royal Engineers, who was expected, on the night of the 15th instant, in the *Psyche*, from Marseilles, to take part in the destruction of the fortifications of Vido and some of the other works in the island of Corfu, as already mentioned in another paragraph in this journal. The expedition for the repair of the Malta and Alexandria cable started on Saturday night, the 20th instant, for the neighbourhood of Benghasi, where the injury was believed to exist. The chartered steamer *Fanny Lambert*, Captain Christopher, carried with her a sufficient quantity of cable and all the necessary apparatus for this operation. Mr. Canning, engineer, and Mr. De Sauty, electrician, have preceded her with an efficient staff. Mr. Gibson, the Government inspector, accompanies the expedition on behalf of the Home Government, and Lieut. Drew, R.N., from Her Majesty's ship *Hydra*, is to assist in the navigation of the vessel. Her Majesty's screw steamer *Surprise*, 4, Capt. N. H. Whyte, had proceeded with the *Fanny Lambert* to attend upon her, and render any assistance that might be required. The local military submarine telegraph in the grand harbour between Forts Ricasoli and St. Angelo has been for some time past out of order, and considerable inconvenience has been caused thereby to the garrison. Communication was re-established in December, but soon afterwards (in January) a steamer, dragging her anchor, again severed the line. Through the exertions of Mr. Gibson advantage was taken of the presence here of the repairing staff of Messrs. Glass, Elliot, & Co., and there was every reason to believe that the cable had now been effectively repaired. [On going to press, we learn that the cable has not yet been repaired.]

THE GLOBE TELEGRAPH COMPANY (LIMITED).—The directors of this company have applied for Parliamentary powers to purchase various patents granted Mr. Henry Wilde, of Manchester, for improvements in electric telegraphs, and for carrying out a system of private electric telegraph communication between the Government offices and other important public and private establishments within the United Kingdom of Great Britain and Ireland by means of such instruments.

THE PERSIAN GULF TELEGRAPH.—Bombay, January 22.—The *Marian Moore*, which arrived there on the 22nd of December, 129 days from London, had left for Gwadur, on the Mekran coast, in tow of Her Majesty's ship *Semiramis*. The *Kirkham*, with 185 miles of the cable, including six miles of heavy shore end, reached Bombay on the 13th instant, 120 days from London, and goes to Gwadur, towed by Her Majesty's ship *Zenobia*. Sir Charles Bright had left for Kurachee, with Colonel Stewart, in Her Majesty's ship *Coromandel*, and will meet the cable ships at their destination about the 29th instant, when the submersion of the line will commence from the *Kirkham*, which will be towed, after landing the shore end, in a westerly direction, towards Ras Jask. When the whole of her cable has been laid from the three iron tanks in which it is coiled, the end will be passed on board the *Marian Moore*, and the paying out will be continued from her as far as Ghubeht Ghazirch, a sandy inlet near Cape Mussendom, and about 12 miles from Khasab, where the station is prepared. From this point the cable will be laid from the *Assaye* towards Bushire, and the *Tweed* will supply the remainder to the head of the Gulf. It is expected that the work will be completed in three months. The following is an extract from a private letter, dated Bombay, 27th January, and arrived by the last mail:—"The *Marian Moore*, the first of the cable ships, arrived about a week before us. The *Kirkham* arrived on the 13th instant. The *Assaye* and *Amber Witch* ought now to be here; but of these we know nothing recent. The *Tweed* seems likely to be in first, she having been seen at Galle on the 25th instant. On the 21st instant the *Marian Moore* and *Kirkham*, accompanied by three other steamers, left Bombay, with Colonel Stewart and Sir Charles Bright, the staff for laying, and also such of the clerks as had before arrived, for Gwadur, between which place and Mussendom it is proposed to lay the first section of the submarine line."

RAILWAY TRAIN SIGNALS.—It appears that the French Minister of Public Works has addressed a circular to the directors of railway companies, recommending measures, which it is hoped, when carried into effect, will add greatly to the comfort and security of travellers. In the first place the Minister has decided that the regulations by which the guards of trains are required to be in constant communication with the engineer shall be strictly carried out within a period of three months.

UNITED KINGDOM TELEGRAPH COMPANY.—This company having extended its wires to Stockton-on-Tees, Sunderland, and Newcastle-on-Tyne, messages of twenty words can now be forwarded to those towns from the metropolis for 1s.

THE UNITED KINGDOM TELEGRAPH COMPANY opened their offices for public business at Stockton, Sunderland, and Newcastle, at 5 p.m., on Thursday, Feb. 23rd. This company have experienced much difficulty in their erections in the north-east district from opposition by landowners, &c. At Eland they were compelled to remove the poles in the streets after they had been planted and finished in a style most creditable to the company. In several other parts also poles had to be removed. During the heavy gale of wind on the 13th and 14th their wires across the Tyne were blown down, doing considerable damage to property. They have succeeded in obtaining the patronage of most of the important telegraphing merchants by securing them as shareholders.

WE are happy to have to announce that Mr. George Sheward, one of the directors of the London District Telegraph Company, and chairman of the board of management of the Telegraph Clerks' Provident Fund, was elected a director of the London and North-Western Railway Company at the last general meeting of the company.

CAPTAIN H. SCHAW, Royal Engineers, who is at the head of the Electric Telegraph and Photographic Schools at Chatham, has proceeded, by order of the Government, to Corfu, for the purpose of superintending the demolition of the fortifications in that and the neighbouring islands.

SUBMARINE TELEGRAPH COMPANY.—The messages for Denmark, Sweden, and Norway, can now be telegraphed to Warnemunde; from thence they are despatched by boat, leaving every other day (on the odd days commencing from 13th inst.), to Ystadt, from which place they are telegraphed to destination. The boat transit occupies about twelve hours. Messages are also sent by post from Ystadt to place of destination. During the month of March the boat will be despatched on even days.

MAGNETIC TELEGRAPH COMPANY.—At a special meeting of the Improvement Commissioners for the town of Huddersfield, held in the board-room, on Wednesday, the 16th instant, the Chairman (Mr. Sykes) read a letter he had received from the Magnetic Telegraph Company, stating that they were about to establish a branch at the shop of Mr. Wood, New-street, and requesting permission from the commissioners to carry their wires across the streets if they could arrange with the owners of the property for leave to fix their wires. Permission had been given in Manchester and other towns. The Chairman said an application of a similar nature had been made by another company some time ago, and it was granted so far as the commissioners were concerned. He supposed he might write and give the permission. —Mr. N. Learoyd said he thought so.—Mr. Clough said it was a matter that required a little consideration. If they had their wires up twelve months they established a right to have them up.—Some conversation took place on the point, and ultimately it was agreed that the matter should be referred to the paving and drainage committee, it being understood that the special Act of the company should be referred to, to see if, by giving the permission requested, the commissioners would sanction anything that might injuriously affect the ratepayers; if not, the permission should be granted.

TELEGRAPHIC INSTRUMENTS.—At the Seventh Annual Conversazione of the Huddersfield Literary and Scientific Society, held in the Philosophical Hall and Assembly Room, on Thursday evening, the 18th instant, a number of telegraphic instruments were exhibited, supplied by two telegraph companies—the Globe and the United Kingdom. The former exhibited their new private telegraphs, which were very interesting to the spectators, as the message forwarded could be read by any one as it was spelled on a dial encircled with the letters of the alphabet. But the instruments exhibited by the latter proved the most attractive. One of them, "Hughes' type-printing telegraph," was in connection with Manchester, and messages were continually sent and received during the whole of the evening, and all of them were clearly printed on paper, a long strip of which, something like an enormous roll of tape, was placed in a cylinder near, and regularly fed the machine. The specimens of printing and telegraphy produced by this instrument were sought after with the greatest avidity, and an animated conversation was maintained with the operator at Manchester for about three hours. An ingenious application of electricity as a fire alarm was also exhibited and was much noticed.

ON Tuesday, the 16th instant, an admirable lecture was delivered at the Athenæum, Exeter, by Mr. Bartholomew, on "Electric Telegraphs." His intimate acquaintance with the subject, theoretically as well as practically, renders Mr. Bartholomew a lecturer always heard upon this and kindred subjects with profit and pleasure; and we are pleased to find, from the testimony of those who attended at the Exeter Athenæum, that more was learnt respecting this most interesting, although little understood subject than had ever been the case before. Mr. Bartholomew made special allusion to the Atlantic Telegraph, which he was well qualified to do, having been connected with it from the first starting of the expedition in 1856 to the close of its successful submersion in November, 1858. The reference made to this great undertaking proved a point of great interest to Mr. Bartholomew's audience. We understand that Mr. Bartholomew has some idea of visiting the north, and we think the good people in Scotland will do well to avail themselves of the opportunity which may be presented of hearing something about telegraphy from one who has spent nearly 20 years in the profession.

MISCELLANEA.

ELECTRO-MAGNETIC ENGINE.—We extract the following from a New York paper. Our readers must attach their own value to the statements made:—Captain John Reeves, of New York, is the inventor and patentee of an electro-magnetic rotary engine, for producing motive power by electricity, to any extent and for any purpose required. The inventor, in his experiments, has discovered, and is now prepared to verify the fact, that electricity can be diffused over surfaces to the extent of hundreds of superficial feet, and thereby cause an electro-magnetic attraction, which acts on, and sets in motion, the most powerful machinery for producing motive power; and this at a most reasonable expense for material consumed. The method on which the inventor founds the principle for producing and augmenting motive power by electricity is peculiar in its machinery, but comparatively similar in its nature to that by which other elements are brought into practical use—that is, the greater the area of surface exposed to the action of the motive or first cause, whether it be wind, water, steam, or electricity, the greater the effect produced in motive power. In regard to the expense, the inventor makes this comparison—In extending the area of a surface in a steam-engine to increase the power, the momentum being the same, the ratio of expense will increase in proportion. But electricity, being of a different nature, when the area of surface is extended, extra power is obtained, with a diminishing ratio of expense. For instance, suppose it costs 1·25 dol. per horse power for the material to keep a 50-horse power condensing marine steam-engine at work for 24 hours, and the area of surface in the piston is extended sufficiently to produce 100-horse power, the cost per horse power for producing the additional 50 would be equal to that of the first 50. But suppose the cost is 10 cents per horse power for material to keep a 50-horse marine electro-magnetic rotary engine at work for 24 hours, and the area of surface is extended to produce 100-horse power, the additional 50-horse power would be obtained at a quarter less cost than the first 50; therefore, the whole expense would be greatly reduced. A marine electro-magnetic rotary engine, and all its accompaniments for a six months' cruise, would not occupy more space in a vessel than a marine steam-engine of equal power, saving the room now required for furnaces, boilers, coal-bunkers, &c. A vessel to be propelled by electricity can be built with one-fourth less capacity, at less expense, with finer lines for speed, carry equal burden, and in every way possess superior qualities to one built for being propelled by steam. Again, a vessel propelled by electricity can be entirely closed up when required. This will make it available for arming in a peculiar manner, either for assault or defence, and navigable submerged or on the surface of the water. This invention is destined to make great changes, not only in our river and ocean navigation, but also in railways of every description. The inventor has a working model at the Capitol, with plans of different descriptions, which he is preparing to exhibit to the Government.

Improvements.—During the year 1863 no fewer than 53 patents were sealed for improvements in the manufacture of telegraph instruments, insulators, cables, &c.

Substitute for Gutta Percha and India Rubber for Insulating Purposes.—At a late meeting of the French Academy of Sciences, M. Serres gave an account of the Valata, a shrub which abounds in Guiana, and affords a juice which he asserts is superior for many purposes to gutta percha, but more especially as an insulating material for enveloping telegraphic wires. The milk or juice is drinkable and used by the natives with coffee. It coagulates quickly when exposed to the air, and almost immediately when precipitated by alcohol, which also dissolves the resin of the Valata juice. All the articles made with gutta percha can be made with the sap of the valata juice, and it has no disagreeable smell. When worked up it becomes as supple as cloth and more flexible than gutta percha. M. Serres exhibited a number of articles manufactured of Valata milk that at the present time it seems, from M. Serres' account, have not become of commercial export.

"Deflections," or "Earth Currents."—Occasionally, especially during the aurora borealis, strong currents, sometimes steady, at other times changing their direction very rapidly, appear in the wires. These currents are not caused by atmospheric electricity, for they cease if a wire be disconnected at one of its ends, and they appear equally in buried as in suspended wires. They seem rather to be caused by currents flowing from one part of the earth to another, which enter the wires by one of their earth connections, and leave them by the other when the currents happen to be passing in that direction. The wires are constantly traversed by these currents, but it is only at times that they attain sufficient force to affect the apparatus. They appear most frequently, and have greatest power on the lines lying N.E. and S.W.; but it appears that the direction of the current changes with the hour of the day, so that one line may be more strongly "deflected" in the morning, another in the afternoon. The current has frequently been seen to leave one circuit and to appear upon another previously free. Communication may be kept open by means of a magnet, to counteract the effect of the current. But when deflections are very strong and very variable in direction, the best method is to disconnect two wires from earth at both ends, and to use one as a *section wire* to the other in place of the earth.—*Culley's Handbook.*

Magnetic Phenomenon.—Dr. A. von Waltenhofen has communicated to *Dingler's Polytechnisches Journal* an account of a curious magnetic discovery which he has recently made. It is a well-known fact that the magnetism of an electro-magnet does not entirely disappear with the cessation of the magnetizing current. Dr. A. von Waltenhofen has, however, observed that the amount of this residual magnetism, as it is called, is dependent upon the manner in which the current is interrupted. If this interruption take place suddenly, the residual magnetism is much less than when it takes place gradually. A still more interesting circumstance has been observed by him—viz., that the residual magnetism obtained by suddenly breaking a very strong current, is sometimes of an opposite nature to that previously existing in the electro-magnet. This fact, which he has hitherto only noticed in very soft iron, is of great interest, inasmuch as it furnishes a new and simple proof that magnetism is not caused by the separation of two fluids, but by the motion of magnetic molecules, to which is opposed a certain amount of frictional resistance. With much ingenuity he compares the state of each magnetic molecule of the electro-magnet to that of a spring which is bent back. If the spring be suddenly released, it will return very nearly to its original position, or even go beyond it. On the other hand, if it be released gradually, it will stop at a point still further removed from its original position.

Rapid Communication in 1846.—(From an old Magazine.)—From the description given of Mr. Bain's invention, it will be seen that the rapidity of communication by it is limited by two circumstances only: first, the time required to punch out the holes in the roll of paper of the transmitting apparatus before committing it to (may we not say ?) the press; and, second, the number of intermissions of the electric current which can be effected in any given time—one intermission being requisite for every letter or sign. Now, the time required for the first part of the process must depend on the number of letters or signs which it is in the physical power of a clever hand to punch out in a given time, which can scarcely exceed on the average 100 a minute; but the passage of the electric fluid is so instantaneous (faster than lightning) that we make no doubt from 500 to 1,000 intermissions in a minute may be readily effected in the way proposed by Mr. Bain. Supposing, therefore, a communication be once punched out in paper, and the paper to be committed to the transmitting apparatus, it will require but a few minutes to convey that communication to any distance however great, and that, too, in as complete a state as any letter, despatch, circular, or pamphlet is now conveyed bodily by post. We foresee the perfect practicability in this way of all the leading articles of the *Times* (*ex gr.*) being reprinted and republished in Liverpool, or Glasgow, or Edinburgh simultaneously with their publication in London! It would only be necessary, in order to effect this incomparable desideratum, that there should be placed by the side of each compositor a man, with a set of punches and a roll of paper, to punch as fast as the other composed—and that, when a column was completed, it should be sent off to the electric telegraph-office, to be transmitted to Liverpool, Glasgow, or Edinburgh, there to be rendered from the telegraphic characters into the ordinary characters of our mother tongue, reprinted and republished. Has any other plan of electro-telegraphic communication yet proposed offered advantages equal to this? We believe not. Suggestions, pointing to such a plan, have, we are aware, been thrown out before now; but Mr. Bain has, at all events, the unquestionable merit of being the first to turn to practical account a principle which all the other able men occupied with the same subject have practically neglected.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine mixed, first and second qualities . .	2/3 to 2/6 per lb.
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India Rubber.

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Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	104 to 107 x. dv.	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	½ dis. to par	—
10	Mediterranean Extension Tel. .	all	3½ to 4½	—
5	London District Telegraph Co..	all	1½ to 2 [& ex.n.]	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

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THE TELEGRAPHIC JOURNAL.

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AN INSTITUTE FOR TELEGRAPHISTS.

A nation's progress is found to be in exact ratio with the prosperity of its home institutions; and England's pre-eminence in the arts and sciences may be attributed in a great measure to the facilities which exist for communication between her experimentalists and men of science. The country abounds in Societies of Arts, Institutes of Engineers, Architects, &c., Unions for all purposes conceivable—indeed, every profession is represented by some organisation except Telegraphy. Why is this the exception? Is it so unimportant—so juvenescent—as to be unable to sustain an Institute wherein all engaged in telegraphic pursuits may meet periodically for discussion, and to take counsel together as to the best means of realising any important project? Or is it that there is so much of the *meum* and *tuum* animating the men engaged in the art, that they cannot be at one in the realisation of so important a scheme? But perhaps in these reflections we are aiming beyond our object. We purposed in the outset a few considerations as to the practicability of establishing an Institute for Telegraphists—liberal in its general features, and offering advantages to all persons engaged in this branch of science.

No difference of opinion can exist as to the desirability of friendly communication between the employés of telegraph companies, or as to the importance of strengthening by union the interests of the persons engaged in telegraphy, on whose behalf we speak, rather than for scientific or professional men.

Hitherto, all efforts tending to this end have been frustrated by senseless jealousy and narrow-mindedness. The various companies are competitive in character, and it would seem that this trait in the organisations determines in degree the conduct of the employés; and, as each company is "limited," we may, perhaps, be able to account for individuals on the several staffs limiting their friendly relations to the amenities of society. This condition of things will admit of great alteration. Class-exclusiveness has always seriously retarded improvements; and now that the telegraphic service of the country has become so important, it behoves all those who are interested in its progress to promote a greater cordiality than has ever existed between telegraphists—from the manager to the messenger.

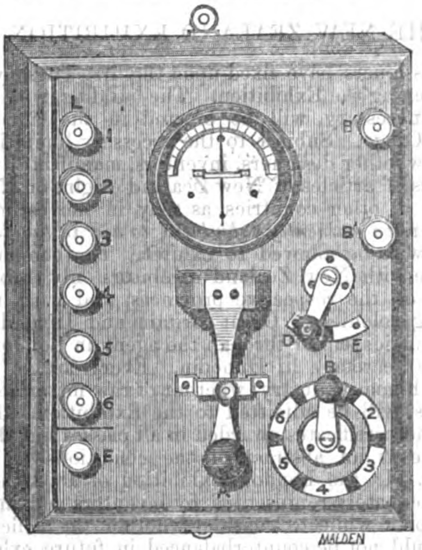
How to attain this object is the question! Institutions have sprung up among the employés of the many companies in London, and have been productive of good; but, like Pepper's Ghosts, they are not substantial—they do not last long. The elements of cohesion are wanting, or, as one of our correspondents says, referring to this state of affairs, "it is all *repulsion* without *attraction*." It is time that this discordance ceased, and that harmony prevailed. There is need of a fraternal union, which might be materially advanced by the establishment of an Institute—some centre of attraction for all. Let us, then, consider the possibility of meeting this requirement. The greatest difficulty likely to be experienced in carrying out a scheme of this kind is that of awakening and sustaining an interest among those who should be the readiest to perceive the advantages of co-operation. Mankind is very selfish, and it may be politic to avail ourselves of this distinguishing feature in order to further our legitimate designs. This consideration brings us to the point; and we venture to suggest that, were the Telegraph Clerks' Provident Fund, the Dramatic and Recreation Clubs, Discussion and Literary Classes, in connection with each company, incorporated under a representative management—vigorous in its operations and progressive in character—an Institution might be inaugurated which would be creditable to the employés and a honour to the service. The patronage enjoyed by some of these local unions—at present comparative failures—if concentrated, would enable a committee to submit comprehensive measures personally advantageous to the members, and thus kindle an interest among all classes in the welfare of the association. The cost of management might be at the minimum, the benefits to be derived at the maximum, and then we should have the pleasure of recording more favourable resolutions than those arrived at in a recent meeting of the Magnetic Company's employés (when the claims of a very useful organisation were submitted for consideration), and which were duly published in our columns. A work of this kind only needs a commencement; it might be initiated with grace by the secretaries of the several clubs and funds before enumerated. If begun in a dispassionate spirit, and carried out in a business-like manner, it will ensure the support of all persons engaged in telegraphy, and cannot fail to meet with patronage and approval among shareholders, directors, and others, whose aid will doubtless prove acceptable.

THE TELEGRAPH CLERKS' PROVIDENT FUND.

We have to announce, with great pleasure and satisfaction, that Her Royal Highness the Princess of Wales has graciously become the patroness of the above excellent institution. Her Royal Highness has also contributed a donation of £10 10s. towards the Fund. We are glad to find that the Society continues to gain in number and strength, thanks to the exertions of its indefatigable secretary, Miss Oppenheim, and that already its advantages have been experienced by members incapacitated by illness to follow their occupations. A case has been brought before us this week of the widow of one who died in the telegraph service, and who is left, with her infant children, in a state of distress and helplessness. We find that Government Annuities, not exceeding £30 per annum, may be contracted through the Society, the annual premiums for which may be paid by monthly or quarterly payments, and that a husband and wife may each hold any of these annuities. We append a few particulars respecting this feature of the Fund, showing the advantages to be derived by the purchase of annuities:—If the annuity be purchased, and the money required for the same shall be actually paid into the account of the Commissioners at the Bank of England or Bank of Ireland, after the 5th day of January and before the 5th day of April, such annuity will be payable the 5th of July and the 5th of January in every year; if after the 5th day of April and before the 5th day of July, it will be payable the 10th of October and the 5th of April; if after the 5th day of July and before the 10th day of October, it will be payable the 5th of January and the 5th of July; if after the 10th day of October and before the 5th day of January, it will be payable the 5th of April and the 10th of October. These annuities are not subject to the income tax. Our readers will find the subject more fully referred to in the *Telegraphic Journal* of the 30th January, page 59.

SAX'S ELECTRIC COMMUNICATOR.

Under the title of the Electric Communicator, Mr. J. Sax, of 445, New Oxford-street, has devised a simple means of communication between the most distant parts of large establishments, such as banking-houses, offices, hotels, factories, &c. The instrument is much more simple in its details than the electric telegraph, can be readily understood by any person of average intelligence, is cheap in the first cost, and is not liable to derangement.



The entire working parts are contained, as represented in the engraving, in a case 8 in. by 6, by 2 in. in thickness; this can be placed against the wall of an office or other room without taking up any useful space. The two screws marked B′ B′ on the right hand, at the top of the woodcut, serve to secure the two wires from a small galvanic battery, that can be placed in any convenient corner out of the way. The screws marked 1 to 6 serve to attach wires running to the bells in the places to which the communications are to be made; these may be as numerous as required. The screw E is for attaching a wire from the earth, that brings back the return current from the alarm bells, and completes the electric circuit. One "earth," as it is technically called, answers for any number of wires. The circle marked with figures in the right hand lower corner of the cut, represents a contrivance known to electricians as a commutator, by means of which the electric current can be sent in any required direction. On moving the handle B, which now covers the figure 1, to any other number, the current can be sent along the corresponding wire.

Let us imagine a communication required to be made with the workshop or room to which the wire number 5 is carried, and which may be situated any distance away. All that is requisite is to place the handle B over the figure 5, when the battery is in immediate communication with wire 5, and the current can pass in no other direction. On pressing with the finger the knob A, at the bottom of the instrument, the circuit is at once completed, and passes along the whole distance of the wire from 5 to the room in which the bell is situated, returning by the "earth."

In order to render the instrument more serviceable, and to enable it to give a variety of signals, the small handle above the commutator is added—the knob C of which can be moved over either D or E. When in the former position, as is represented in the cut, a single stroke or signal is given on the bell in the distant room to which the message is sent, and this signal is repeated as often and as rapidly as A is pressed down with the finger. On the other hand, when the handle C is moved over E, a continuous alarm is sounded in the distant room as long as A is pressed down. It is obvious that this power of ringing a continuous alarm bell, and also of making any number of single signals, gives a ready facility for devising a code of signs sufficient for almost all practical purposes.

Let us suppose each workman in a workshop to have a number; he may be instantly summoned to the head-quarters by signalling his number; or by sounding the alarm as may be understood, before or after the signals, a boy may be dispatched to the office with an account of the state of his work. Of course a correspondence cannot be carried on as readily as with an electric telegraph, but for the purposes of communicating with the different parts of any large establishment, this simple, inexpensive apparatus has many advantages; its indications can be understood by all, and its cheapness and non-liability to get out of order strongly recommend it.

The object of the galvanometric needle and large dial in the centre of the instrument, is to show the operator that the exact signals he wishes to make are being recorded in the distant place to which he is signalling. When we add that the cost of this apparatus is only from £3 to £4, we think that we have said sufficient to secure its being at once employed in numerous places, where its introduction will be found to effect a vast saving of time, trouble, and expense. The Electric Communicator has been laid down with two bells by Lord Huntingtower, Grosvenor-square.

THE MANUFACTURE OF IRON WIRE.

It is marvellous that so little interest is felt by the public in the development of the telegraphic system. The impetus which it has given to various manufactures could be shown by a comparison of the consumption of *matériel* in the numerous works which have been projected and carried out during the past twenty years. But this is apart from our present purpose. A very general opinion prevails that telegraphy is a morbid, stagnant profession; useful, it may be, but unproductive of trade, lacking interest for the manufacturing community, and failing to develope the resources of the country to any great extent. These fallacies we shall endeavour to dispel at some future time. Our purpose is now to direct the attention of our readers to one of the most interesting manufactures which have received a stimulus from the telegraphic service. Iron wire is used very largely as a conductor in railway, house-top, and over-ground work generally, and is also very extensively employed as a sheathing for submarine cables. Some idea of the extent to which it is applied may be gathered from the circumstance that 3,000 miles of the Atlantic cables of 1857-8, were sheathed in 126 separate wires, equal to 378,000 miles in length. By far the greater quantity of wire used for telegraphic and other purposes is manufactured in Birmingham and Sheffield, but there is reason to believe that several Belgium firms have of late proved formidable competitors to our large contractors. The processes which we are about to describe are those adopted by English manufacturers.

We proceed to a shed containing a smelting furnace, the fire of which, composed of charcoal, is constantly urged by five or six blasts, proceeding from the mouths of as many "tuyeres," or "tew-pipes," as the workmen usually term them. The "blowing engines," which supply the place of the old-fashioned bellows, are moved by water or steam power, and consist mainly of four cylinders, about three feet in height, and nearly equal diameter, open at the bottom. These are supplied with closely-fitting pistons, moving alternately up and down; and as the further (closed) ends of the cylinders communicate with a common air-chamber and blast-pipe, a constant stream of air is thus kept up, and projected upon the glowing fuel through the "tuyeres," which are, in fact, branches from the main pipe. The iron, which is thrown in with the charcoal, is reduced to a liquid state in about three hours, and being allowed to flow out at the bottom of the furnace, by the removal of a plug, quickly fills an oblong trough, prepared to receive it, and becomes a seething bed of molten iron. Cold water, in small quantities, is then sprinkled on it, and the crust formed on the surface is broken by an iron rod. The produce—a flat mass of brittle iron—is afterwards reduced to fragments, to be remelted, and otherwise worked, till it becomes sufficiently tough for rolling into bars. The intermediate processes which effect this change consist of puddling and rolling. The puddling furnace is built much like a baker's oven, with a low division in the centre, and a high chimney at the furthest end. The fuel being placed in the outer, and the iron in the inner part, the flame of the former passes over the latter, and from the form of the furnace exposes it to an intense heat. When melted, the iron is stirred, and occasionally sprinkled with water; the effect of the operation being first to reduce it to a kind of coarse powder, and then, upon the addition of a powerful blast, to cause it to assume a pasty consistence. It is

divided, whilst in this state, into lumps, which are then subjected, either to the pressure of rollers, or the action of ponderous hammers worked by water or steam power. Thus reduced to bars of about thirty inches in length, and three in thickness, and of peculiar toughness, it is ready for being reduced to wire.

The machinery by which this is effected consists of a series of grooved rollers, revolving at the rate of about 350 turns a minute. They are arranged in threes, regularly graduated from the largest to the smallest. Let the reader imagine himself in a large, partially open building, facing these rapidly revolving rollers—a glowing furnace on his right, and, stationed each at his post, a motly group of men and boys, some with tongs, another (a boy) with an iron hook, others behind the rollers—all looking peculiarly active, hot, and ruddy, in the firelight. Suddenly a glowing bar of metal is tossed from the furnace across the paved floor, alighting with astonishing precision at the feet of those who tend the rollers. In an instant it is seized by two stalwart men, armed with the aforesaid tongs, and one of its ends presented to the largest groove in the lower pair of rollers. ~~It is out of sight~~ in a twinkling, vanishing with a sharp crack, and before the spectator has time to wonder whither it has been so summarily sent, behold it appearing at the second groove in the upper rollers, still glowing, but increased considerably in length, whilst its bulk is similarly diminished. Again seized, like a fiery serpent by the tail, it is sent back as before through a still smaller groove, appearing again in an instant from above; but now the length is doubled and trebled, and as it issues from the last rollers in glowing, snake-like gyrations, it is seized by one end and presented to a winding wheel of iron with a broad rim, and converted into a neat coil. The whole of the operations here described, from the tossing of the heavy bar from the furnace, to the coiling it as wire upon the wheel, are performed in little more than one minute, during which the metal is reduced from a diameter of three inches to one-eighth of an inch, and increased from thirty inches to about thirty feet in length. The wire thus formed is comparatively brittle, and would not, on account of its hard texture, be fit for further reduction in size, as this has now to be effected by a different operation termed "drawing." To prepare it for this, the metal must be *annealed*. This is effected by piling a number of coils within a kind of air-tight furnace, in which it is gradually exposed to a high temperature and allowed to cool slowly. After this treatment the wire is found to be soft and pliable, and is taken to the drawing-shed.

Imagine a long table, surmounted by a row of upright iron drums revolving vertically, being put in rapid motion by a steam engine. At the side of each drum is the draw-plate, a mass of iron, faced with steel, of a rectangular form, in the centre of which is a conical hole. The object now to be effected is to reduce the size of the wire, by forcibly drawing it through the hole in the draw-plate, which hole is smaller than the wire itself. The old method was to draw it an inch or two at a time by means of pincers; but as these required to be advanced, so as to take a fresh grip every few inches, the wire was turned out in a very rough manner, presenting a series of indentations wherever the pincers had taken hold of it. The present method is a vast improvement, and leaves the wire not only free from flaws, but highly polished, and of equal diameter throughout its whole length. The process is as follows:—One end of the annealed coil is filed to a point sufficiently acute to allow it to pass easily through the hole in the draw-plate. Having been pushed through as far as it will go, it is seized by a pair of curiously contrived pincers which are attached to a chain, connected with the longest end of a lever, and moved to and fro when required by the action of a cam or eccentric, fixed to the vertical axis of a drum. This drum is not welded to its axis, but is allowed to slide upon it till needed, when, by means of a lever and a treadle, it is brought down upon the eccentric. In this position, two pegs fall into similar holes in the drum, causing the whole to revolve together. The end of the wire being seized by the pincers as aforesaid, the action of the cam upon the lever causes it to be dragged forcibly forward through the draw-plate for a short distance—the pincers, being again advanced by hand, take a fresh grip of the wire nearer to the plate, and the same action being repeated at every revolution of the cam, a sufficient length is drawn to allow of its being attached to the drum, where it is fixed by a screw clamp.

The drum is now lowered, and caused to revolve rapidly by steam power, and the wire, being thus wound upon it, as it issues from the draw plate, is converted into a coil, which is then tied with a short piece of binding wire and set aside for the market. The hole in the draw plate is kept constantly greased, so that there is no longer that harsh grating sound that, in old times, set the spectator's teeth on edge. The whole operation, from beginning to end, is almost noiseless, and with such facility is the wire drawn by the giant force of steam, that a casual observer might suppose the metal to be as soft as lead. The size of the wire being regulated by the hole in the draw plate, the workman has only to repeat the operation with a graduated series of holes, in order to attain any required degree of fineness.

THE NEW ZEALAND EXHIBITION, 1865.

The Commissioners have fixed upon the first Tuesday in January, 1865, for opening the Exhibition. The building, with such annexes as may be necessary, will be erected in the city of Dunedin, province of Otago. Subject to the necessary limitations of space, all persons, whether designers, inventors, manufacturers, producers or possessors of articles of New Zealand origin, or of such others, the produce of other countries, as may in the estimation of the commissioners *be eminently calculated to aid in the development of the colony*, will be allowed to exhibit. The commissioners will communicate with New Zealand exhibitors only through the local committees of the respective provinces, and with those of the neighbouring colonies of Great Britain and Ireland, and of any Foreign countries, either through the agent in London, or directly through the secretary in Dunedin. Every article produced or obtained by human industry, whether of raw materials, machinery, or Fine Arts, will be admitted to the Exhibition. Juries will be appointed and certificates awarded in all classes but the Fine Arts.

The above is an abstract of the conditions of this colonial undertaking. In the London Exhibition of 1862 the telegraphic art was inadequately represented by inventors and manufacturers, and it is worth while to consider whether the deficiency of that occasion should not be counterbalanced in future exhibitions. So far as we have been enabled to observe, there is a disposition on the part of the people to pay attention to any explanation of the operation and uses of the electric telegraph. If a lecture is announced to be delivered on telegraphy, as was the case at Exeter a short time ago, we generally find large audiences. If a soirée is held, and any appurtenances of the telegraph are exhibited, they are sure to attract attention. This growing interest in the subject should be encouraged; and if private firms will not go to the expense of affording the public information, our flourishing companies might forward a few instruments, &c., to any place where the dissemination of knowledge is likely to prove useful in bringing the telegraph into more general use.

We wish the New Zealand project every success, and hope that if our manufacturers are indifferent to this appeal some of the large corporate bodies will give a favourable consideration to our suggestion, and that telegraphy will be well represented at Dunedin in 1865, as it is "eminently calculated to aid in the development of the colony."

THE ELECTRO-MAGNETIC PHONOGRAPH.

By J. Beverley Fenby.

So keenly have musicians at all times felt the extreme tediousness of writing music by hand, and the impossibility of preserving the most valuable impromptu pieces in their full and flowing beauty, that immediately on the introduction of the pianoforte into England, strenuous efforts were made by men of inventive skill to supply the instrument with the means of registering the music performed upon it.

"The first pianoforte seen in England was made by one Father Wood, an English monk at Rome, and by him sold to Samuel Crisp, Esq., who sold it again to Fulke Greville, Esq., for one hundred guineas."—*Rimbault's History of the Pianoforte.*

This was about 1757.

The Rev. — Creed would appear to have been one of the first, if not the first, to think of constructing a melographic piano or harpsichord, and in the year 1747 he sent to the Society of Arts a paper, entitled "A demonstration of the possibility of making a machine that will write extempore voluntaries, or other pieces of music, &c." —*Phil. Trans.*, vol. xliv. p. 445.

There are also obscure accounts of a machine made in 1770 by a monk named Engramelle.

In a German work of 1774, John Frederick Unger, a counsellor of justice at Berlin, claims priority of invention against Mr. Creed, though it seems most probable that each made a similar invention unknown to the other.

There is no doubt whatever that the Académie of Berlin was presented by Hohlfield—an ingenious mechanic who received some suggestions from Euler—with a machine which, to a limited extent, answered its purpose. It consisted of two cylinders moving paper between them, on which, by means of a crayon, each key made a mark when pressed down in the act of playing. But not only was the action of playing very fatiguing, but the music must have been of a most inconvenient width—that of the key-board—and without any stave, accidentals, &c.; in fact, a mere series of dots showing such and such keys were pressed down in the course of the performance, but utterly failing to mark the time, key, or accidentals. The Académie, however, in consideration of the great ingenuity of the contrivance, rewarded the inventor with a handsome gratuity.

"In 1827 M. Carreyre made trial, before the Committee of the Fine Arts of the Institute of France, of a *melographic piano*, which consisted of a clockwork movement, which unwound from one cylinder to another a thin plate of lead, on which were impressed, by the action of the keys of the instrument, certain peculiar signs, which might be translated into the ordinary notation by means of an explanatory table.

"After the experiment the plate of lead was removed to make the translation, and a commission was appointed to report; but as no report was ever made, it is probable that the translation was not found to be exact. At the same time M. Baudouin read before the institute a paper, accompanying it with drawings, concerning another melographic piano, upon the merit of which we do not find that the institute pronounced."—*Rimbault.*

These accounts prove two important facts: the great efforts made and the small success achieved—this want of success proceeding from the lack of a proper motive power, none having used electro-magnetism—for it must be evident to all acquainted with music that these were as yet nothing more than partially successful experiments, and produced no further results than stimulating inventors to continued exertions.

The causes of failure were many, the most serious being the oversight of endeavouring to derive the mechanical power from the keys of the piano, whereas some power—which, while depending upon the action of the key for its liberation and manifestation, should, at the same time, exert its force without strain upon the key—still remained a desideratum. Such a power is electro-magnetism, as the mere motion of a piano-key—without any alteration in the touch required—may be made to call forth a force of any magnitude, from ounces to tons. Now, in Unger's machine the power was derived from the keys alone, and by direct action, thus rendering the touch of the piano so heavy, that no one could perform properly upon it. For this reason it is unnecessary to consider further its defects. M. Carreyre's, besides being equally objectionable on the score of its unavoidably heavy touch, and arbitrary and unmeaning signs, produced at the best but an indented sheet of lead, a medium for writing music on most inconvenient and unmanageable.

A machine which should register in plain black and white on common paper the music performed, giving the score on the ordinary stave, using the flat, sharp, and natural signs, as in all modern music, accurately registering time, bars, legato and staccato, 8va, alta, and bassa passages, and adapted to all keys, still remained a desideratum, for from 1827 to 1863 no further progress was made, though many continued to give their attention to the subject.

But in 1863 electro-magnetism was applied, and the required conditions were all fulfilled, for a machine was patented January 13th, 1863, which, without altering the touch or appearance of an ordinary piano, is yet capable of registering the most complicated music.

Before giving any detailed description of the construction and capabilities of the phonograph, it may be well to make a succinct analysis of the obstacles to be overcome in the notation, and thus to separate the possible from the impossible.

The most obvious difficulty—and one which, if not overcome, would render all other excellencies nearly, if not quite futile—is the means of marking the various durations of the notes, from the breve to the demisemiquaver, &c. This was a difficulty, inasmuch as the ordinary open, closed, and tailed notes cannot possibly be rendered available in an instrument registering that which is performed upon it.

The following considerations will render this apparent. The longest note is practically but the fusion of a number of shorter notes, from which it follows that on any particular key being depressed, as in playing, its first touch would be the shortest note of the notation, and the machine would immediately print such shortest note, and could not afterwards alter it; for to suppose a piece of machinery to render shorter or longer notes by arbitrary signs, having but a fictitious relation to their duration, is to suppose its possession of a reasoning power, the absurdity of which needs no comment. From these considerations, and others which will readily occur to the mind of the reader, it is manifest that some system is required in which the duration of sound and the performance of the printing may be co-existent, and thus produce a complete reciprocity of action between the two. In other words, a short note must be capable of becoming a long one in the printing as in the playing. This is shown in the phonograph by the length it occupies in the bar.

Having considered the notation, the next thing to which our attention will naturally turn is the mechanical appliances employed to produce this notation. First, then, as to the touch of the piano; this remains, to all intents and purposes, the same as if without the phonograph attached, as the mechanical power is not derived from the motion of the keys, but from a voltaic battery: the only part performed by the key being to bring a small brass stud, on its under side, in contact with a slender spring; this causes an electro-magnet to slide a tracer against the paper, which is continually moving at a fixed rate, and thus marking the note. When the key is no longer depressed the tracing ceases, and the rod slides back; this mechanism being capable of registering the slowest or most rapid playing. The accidentals are printed by revolving type, acted on by the same sliding-rod and magnet. The accidentals are adapted for all keys, so that any number of flats or sharps may be correctly registered; the machine being capable of distinguishing *accidental* flats, sharps, and naturals from those which are proper to the key in which the music may be pitched. That is to say, if the key of A natural be used, F, C, and G, when played sharp, will have no sharp sign in the body of the music; whereas, if the naturals of these notes be struck, or the sharps of any others, suitable accidentals will be printed.

As we have now reviewed the notes and signs proper to them, we will next take the bars. The barring of the music is performed in such a simple manner as precludes the possibility of derangement, and is yet so accurate in adjustment, that it correctly follows the accentuation of the most complicated piece of music. When a rallentando movement occurs, the bar or bars through which it runs will be actually lengthened in such a proportion as will accurately denote the character and expression of that part of the music. The same manifest advantages occur in the matter of legato and staccato movements.

The machine requires only blank paper, as it rules the stave and prints the score simultaneously.

As to many the use of a voltaic battery may *appear* puzzling, the following remarks may not be out of place. In the first place, there is nothing of danger or inconvenience in the battery furnished with the phonograph, as no acid or other corrosive substance is used. The charge consists of sulphate of copper—commonly known by the names Roman or blue vitriol—and water, one charge lasting for some months. The whole is in a neat drawer at the bottom of the machine, and offers nothing of difficulty or unpleasantness in its management, and requiring to be touched only to supply water to it.

Substitutes for Gutta-Percha.—Sir W. Holmes has forwarded to the Council of the Society of Arts, from Demerara, some specimens of a gum termed "Balata," the produce of the Bullet tree (*Sapota Mulleri*), which grows in that colony, and which, he states, possesses the properties of gutta-percha, and may be used as a substitute for it. The specimens include not only the inspissated juice, but also a bottle of the juice itself. Mr. Ondaatjie, colonial surgeon, has forwarded to the Council, from Ceylon, a specimen of the *Alstonia Scholaris*, which he states may be used as a substitute for gutta-percha. It is stated to possess the same properties, and is as workable as the latter. It readily softens when plunged in boiling water; is soluble in turpentine and chloroform; receives and retains impressions permanently, and is adapted for seals to documents. The tree abounds with milky juice, like the gutta-percha, has a fleshy bark and porous wood, and belongs to the natural order, Apocynea. The natives believe that the tree is very poisonous, and class it among their virulent poisons, but Mr. Ondaatjie states that his experiments with the juice, &c., have proved the contrary. These specimens are sent in response to premiums offered by the Society of Arts for the discovery of a substitute for gutta-percha.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 101.)

4. *Relays, or Intermediate Instruments by which Signals, when received, are retransmitted through a Second Circuit.*

Signals sent through long circuits are now very generally received in the first instance by *relays*, or instruments designed to retransmit the signals into a fresh circuit, from a local battery. The second circuit may either be a second line, or simply a local circuit, including a recording or other instrument, which could not be worked directly by the feeble currents received from a distance.

Relays were not generally used in this country or on the Continent in 1851, although described by Professor Wheatstone in connection with his early inventions; they came first into general use in America, and have since then been very extensively introduced in connection with Morse embossing instruments; they are now being to some extent abandoned in favour of the direct ink-writing Morse instruments, of which specimens are exhibited by Messrs. Digney and Messrs. Siemens.

A good relay should be easily adjusted so as to work with any required strength of positive or negative currents. It should work freely under the influence of an extremely small rise and fall of current above and below the strength of current to which it is set (this will, of course, be frequently zero when reverse currents are used), and when once adjusted to a given strength it should be constant—that is to say, should always work with the same rise and fall above and below the strength to which it is set. This condition of constancy is extremely difficult to fulfil when soft iron is used.

The moving parts should be very light, and traverse the shortest possible space, in order to allow of rapid work under the influence of small forces. Finally, the contacts should be so arranged as to be easily adjusted and cleaned.

The relays exhibited by the French makers are of the simplest possible construction. A soft iron hollow cylindrical armature on one end of a rocking lever is attracted downwards by the two poles of an upright horseshoe electro-magnet during the passage of a current. An antagonistic spiral spring lifts the armature again, when the current ceases. This spring can be adjusted by a screw; the contacts required are on the rocking lever. These relays are only intended for rough work; the weight and consequent inertia of the moving parts is so great, that they cannot be worked at any speed with weak currents; moreover, the residual magnetism and coercive force of the large masses of soft iron render any delicacy of adjustment impossible, as will be more fully explained when treating of Messrs. Siemens' relays.

Digney Brothers & Co., Paris, M. (France, 1,414), exhibit an instrument (systême Melloni) in which the movable armature is so shaped as to receive a coil supplementary to that of the main electro-magnet. The received current circulates round this armature in such a direction as to give its ends an opposite polarity to that of the poles of the main electro-magnet facing them. This arrangement does not remove the difficulties arising either from inertia or from residual magnetism, although it must increase the force exerted between the fixed electro-magnet and its armature with a given current, and a given amount of resistance in the coils.

M. Hipp, Neufchâtel, M. (Switzerland, 156), exhibits a good and cheap relay similar in general appearance to the French relay. The peculiarity of this instrument consists in the application to the armature of two antagonistic spiral springs intended to produce greater liveliness or rapidity of motion than can be obtained under the action of gravity alone. The armature is light, and rocks on knife edges.

Siemens & Halske, M., Berlin (Prussia, 1,413), exhibit a *polarized relay*, possessing an electro-magnetic arrangement of great merit, which has also been largely used for direct receiving instruments. The soft iron cores of two straight electro-magnets are joined by a back so as to form the usual horseshoe electro-magnet; this back rests against one pole of a powerful permanent steel magnet, which communicates its own—say north—polarity to both branches of the horseshoe. A tongue of soft iron is centred so that one end can oscillate between the ends of these two branches, and this tongue is supported by the opposite pole of the permanent steel magnet, which is bent into a convenient form for the purpose. This tongue, therefore, partakes of a polarity opposed to that of the branches, in virtue of which, when no current passes round the electro-magnets, it rests attracted indifferently to whichever of the two branches it may happen to be nearest. (This arrangement gives an example of what have been called the unstable receivers.) The effect of a current through the electro-magnetic coils is to weaken the polarity of one branch and strengthen that of the other, so as no longer to allow the tongue to remain indifferently in juxtaposition with either branch, but definitely to attract it to one side, at which side it will remain, until a current in the opposite direction round the coils produces an effect in the branches the reverse of that which last occurred.

By adjusting the relative distances between the two branches and the tongue, and by diminishing the play of this tongue to a small fraction of the total distance which separates them, very great sensibility can be obtained; and, moreover, the instrument, although specially designed to work with nearly equal reverse currents, can be set so as to work with positive or negative currents alone at any strength, as well as with reverse currents of any required relative strength. This plan possesses the advantage of allowing the current to act on highly-magnetized iron. No springs are used, and the position of the branches relatively to the tongue is regulated by a fine screw.

For many purposes this arrangement of receiving electro-magnet and armature is probably the best exhibited; but it possesses the one great defect inseparable from every arrangement in which soft iron plays a part. This defect may be described by saying that similar or equal currents do not produce similar or equal polarities in the soft iron at different times. For, owing to the residual magnetism, a negative signal occurring after a series of positive currents, or after a long positive current, does not produce the same effect on the soft iron as a negative signal occurring after a series of negative currents, or after a long negative current, and neither effect will be the same as that produced by the first few currents received after the soft iron has been for some time free from all electric influence.

This necessary consequence of the coercive force of soft iron frequently renders extreme delicacy of adjustment quite useless; for, although the relay may be set so as to work with an exceedingly small variation in the received current, the continual changes in the condition of the soft iron require to be followed by a continual readjustment undesirable in practice. This defect has led to the invention and use of the so-called *galvanometer relays*, in which the force obtained from the received current is far smaller than in the relays hitherto described, but is constant and always to be relied on.

In galvanometer relays the contacts are produced simply by the deflection of a hard steel magnetized needle under the influence of a coil or coils of wire, without the use of any soft iron whatever. So long as the currents used do not exceed a certain strength, their only sensible effect is to produce an alteration in the position of the needle. They leave its magnetism quite unaffected; and equal effects are therefore always produced by equal currents. These instruments once set require little or no adjustment so long as the condition of the batteries and the line remains sensibly constant.

C. F. Varley, M. (United Kingdom, 2,981), exhibits a simple galvanometer relay with rubbing contacts, much used by him, and found to work very well in practice.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2,864), exhibit another form of galvanometer relay, called the mercurial relay, and invented by Sir Charles Bright. The difficulty found in making good contacts with galvanometer relays, owing to the small force experienced by the needle, is here obviated by the use of mercury contacts, and the oxidation of the mercury is prevented by making these contacts between the needle and a fine stream of mercury constantly in motion. The same mercury is used over and over again, running from one reservoir to another like the sand in an ordinary hour-glass. The reservoirs are reversed when the upper one is empty. This instrument is specially mentioned in the award of a medal to the exhibitors.

This company also exhibits another form of relay, designed by Sir C. Bright, by which positive and negative currents are retransmitted into the second circuit in the order in which positive and negative signals are received. This instrument may be described as having two armatures worked from the opposite poles of two straight electro-magnets. One armature is set so as to work with positive signals, and used to connect the positive pole of a battery with the second circuit; the other set so as to work with negative signals, and used to connect the negative pole of a battery with the second circuit; the two straight electro-magnets stand side by side, and the two steel magnetized armatures are placed at the opposite

ends of the pair, centred on an axis between the two poles. This compact arrangement has been largely used for many years.

T. Allan, M. (United Kingdom, 2,850). The contact pieces of ordinary relays, as has been already observed, require frequently to be cleaned and readjusted, as they are more or less burnt or oxidized by the spark given from the local battery whenever the local circuit is broken.

Mr. Allan has, by a very ingenious arrangement, avoided this inconvenience, and exhibits a "sparkless relay," specially mentioned with approval in the award by which he has received a medal. The *name* "sparkless relay," nevertheless, is hardly correct, for this invention does not consist in the peculiar arrangement of the relay, but depends on the general system of code, relay, and recording instruments.

The code of signals used by Mr. Allan is formed, as already explained, by the grouping of a single line of dots, and a dot is recorded indifferently on the reception of a positive or negative current. His sending instrument reverses the current each time a dot is required, and maintains indifferently a positive or negative current for the space between two dots. The relay differs little except in the arrangement of its contacts from those usually employed, and its armature moves to and fro in the usual way under the alternate influence of the reversals received; but the circuits in connection with the two relay contacts are so arranged that, whether one or other contact is made, the recording instrument prints a dot, and, in the very act of doing so, breaks by a spring contact piece the local circuit which had just been completed by the relay. (The spring contact piece, moved by the clockwork of the recording instrument, also replaces a connection in a second local circuit which had been broken by the previous dot.) The spark caused by the interruption of the local circuit occurs, therefore, at the rough spring contact, where it is of no consequence, and the relay armature on moving to the opposite position when a fresh signal is sent, breaks no circuit and causes no spark. On arriving at the second position, it closes a second local circuit (containing the connection mentioned as replaced by the spring contact when the previous dot was received); this circuit prints a perfectly similar dot to that printed by the first circuit, and in so doing is broken by the spring contact piece, which replaces the connection broken in the first circuit when the first dot was received. Thus, there are two local circuits with two interruptions in each—one in the relay and the other in the printing mechanism. The function of the relay is to close these two local circuits, each of which prints a perfectly similar dot, while the printing mechanism alternately breaks and makes good the two local circuits at the second interruption; when it interrupts the circuit it stops the current, and the spark occurs, but when it makes good the previous interruption, it does not start the current, but only prepares the circuit for the next movement of the relay. The result and object of this cycle of events is to remove the breaks of the circuit from the delicate relay contacts to spring contacts, which, as they are moved by the powerful printing mechanism, can be so treated as to render the spark quite innocuous. Mr. Allan here uses strong rubbing contacts of platinum.

Mr. Allan employs this arrangement with his special automatic system, but it is clear that the same principles are perfectly applicable to any of the common forms of relay, and the Digney or Siemens writer, entailing only the addition of some obvious details.* It is, however, essential that the code or alphabet should be composed entirely of dots. One advantage of the sparkless system is, that the travel of the relay armature between its contacts can be reduced to a minimum, since this plan entirely obviates the well-known chattering or trembling effect produced by the passage of a succession of sparks in the usual relay when the travel is too much diminished. The system appears especially adapted for use with galvanometer relays.

The relay exhibited is composed of a light, hollow, steel magnet, the two poles of which oscillate between the four poles of two horseshoe electro-magnets. The adjustment is obtained by movable eccentric soft iron poles on these electro-magnets.

5. *Receiving Instruments, which show or record the Symbols of the Codes described.*

We now come to the instruments on which the signals are finally received, and either read by eye, by ear, or recorded on paper to be subsequently deciphered. The well-known *needle* instruments are simply various forms of galvanoscope, in which magnets, deflected under the influence of a coil of insulated wire, move an index needle, by means of which the number and order of the currents received are observed by the receiving clerk, who interprets their meaning. Needle instruments are generally used without the intervention of any relay or local battery, and are the simplest, but far from the worst, form of receiving instrument. Examples are shown by—

The British and Irish Magnetic Company, M. (United Kingdom, 2,864), and Messrs. Reid Brothers (United Kingdom, 2,940). They do not require first-rate workmanship, and the examples shown do not present much that is novel, but it is interesting to see how this simple and somewhat primitive instrument holds its ground against a multitude of contrivances of great merit and ingenuity.

The form of magnet in Highton's patent, shown by the British and Irish Magnetic Company, deserves remark. It is a horseshoe, bent from a rather broad steel plate, and centred on an axis, passing through the bend of the horseshoe between the two poles. The coils surrounding this magnet are circular, and lie in planes parallel to that containing the axis, and the line joining the two poles of the magnet. This form of magnet can be powerfully magnetized, retains its magnetism well, and all the moving parts are close to the axis of rotation.

The Morse recording instrument consists essentially of clockwork, by which a strip of paper is drawn forward at an uniform speed, and of an electro-magnet and armature, with which a marking point is mechanically connected. As the armature moves under the influence of the received current, it alternately presses this marking point against the paper, and withdraws it, leaving a series of slightly embossed marks of greater or less length, corresponding to the duration of the received currents; the clockwork is driven by weights, or by a barrel spring, and the speed is regulated by a fly. It is difficult to conceive a simpler recording instrument, and its general adoption on the Continent is, doubtless, due to its simplicity. In order to produce distinct impressions on the paper, the armature must be moved with considerable force, and the instrument is, therefore, in this form almost invariably worked by a relay in connection with a local battery and circuit. This primitive instrument will, however, apparently soon be superseded by improved forms, in which the embossed marks are replaced by ink lines, which can be printed with little pressure, so as in general to dispense with the relay and local circuit.

M. Hipp, Neufchâtel, M. (Switzerland, 156), exhibits a Morse receiver of good practical construction; all the wheelwork and the electro-magnets are under cover in a case, of which the top is plate-glass; the bearings for the pivots are also covered, so that all the moving parts are completely protected against dust. Moreover, the paper roll, the adjustment, the stopping and starting handles, the guide, &c., are conveniently placed. There are more than 1,000 instruments of this kind at work in Switzerland and Italy. It is said that they work a very long time without requiring to be cleaned or repaired. Considering the workmanship, the price—£8 8s.—is very moderate.

T. Sortais, Lisieux, H. M. (France, 1,447), exhibits a self-starting and stopping Morse receiver. In the usual form the paper must be started when a call is heard, and stopped when the message ends. M. Sortais throws these functions on the apparatus itself. The train of wheels is driven by a weight or spring in the usual way, and stopped by a catch, which comes in contact with the fly used to regulate the speed. This catch is a long counterpoised lever centred on an axis, which also carries a ratchet-wheel. The counterpoise tends to turn the ratchet-wheel and lever so as always to free the fly; this motion is restrained by a paul, which arrests the ratchet-wheel. When a current is received, the writing lever moves in the usual way, and lifts this paul out of gear with the ratchet-wheel. The counterpoise falls, turning the ratchet-wheel and releasing the fly; the train of wheels then starts, and draws the paper forward. A projecting tooth on the axis of one of the pinions of the train catches against the teeth of the ratchet, and at every revolution turns it one tooth back, lifting the counterpoise, and bringing the catch nearer to the fly. If the paul is down, each tooth so gained is kept, but if currents continually arrive, lifting the paul, the counterpoise continually falls back to its lowest position, and the clockwork continues in motion. When the message ceases, and the writing lever remains still, the paul keeps each tooth of the ratchet-wheel lifted by the projecting tooth on the pinion axis, until after some revolutions the ratchet is turned

* Mr. Allan differs from the writer here, and says that his arrangement cannot be applied with advantage to the common receivers.

so far round as to bring the catch against the fly, thereby stopping the clockwork. The relative position of the fly, catch, and projecting tooth are so arranged that, when the fly is caught, the projecting tooth is necessarily clear of the ratchet-wheel, which is therefore free to turn the moment the paul is withdrawn. M. Sortais requires no auxiliary electro-magnets, such as are used for the same purpose in an instrument shown by Messrs. Siemens.

The Imperial Telegraph Board of Vienna (Austria, 667) exhibit a Morse instrument, in which they use a little electromotor to drive the clockwork, instead of a spring or weights. This electromotor is automatic, that is to say, it is started by the arrival of the first signal, and stops some time after the last. This is effected very simply. The first movement of the writing lever caused by the arrival of a call or message, lifts a lever off a catch, the lever then falls on to a cam on the axis of one of the train of wheels. The contact between the cam and lever completes the local circuit, and starts the electromotor. Once during each revolution of the cam, it brings the lever into such a position that, if no signal were then received, it would fall on to the catch, and *shortly afterwards* the cam would quit the lever and break the local circuit. This instrument is ingeniously combined and well made, but it will probably for the present be found better in practice to depend on weights or springs for the driving power.

A second Morse embossing receiver, exhibited by M. Hipp (Switzerland, 156), would be of much greater interest were it not for the successful ink-writers exhibited by Messrs. Digney and Siemens. M. Hipp has ingeniously contrived to obtain the force required to emboss the paper from the driving power of his clockwork, using the receiving electro-magnet only as it were to throw the driving power in and out of gear. M. Hipp intended by this means to dispense with the relay, but the "ink-writers" will probably prevent any extended use of his instrument.

Digney Brothers, Paris, M. (France, 1,414), exhibit a receiving instrument, by which the Morse signals are marked in ink on the paper strip. The arrangement of the armature and receiving electro-magnets is similar to that used in Messrs. Siemens' polarised relay: an arrangement which, as already explained, allows the instrument to be worked equally by voltaic or magneto-electric currents. When a current is received, a light lever connected with the armature of the electro-magnet lifts the paper strip, and presses it against a small disc, called the writing disc. When the current ceases, the paper is allowed to fall clear of the disc. This disc is kept in continued rotation by the clockwork, and turns in the opposite direction to that in which it would be driven by the paper when pressing against it. Its edge is kept moist with ink by a saturated felt-roller, which rests on its upper edge. The paper, when lifted against the disc, makes a slight angle at the point where it touches the disc, so as to be in contact with it for a very short distance only. The length of line printed depends on the time during which the paper remains pressed against the disc, just as in the old form the length of mark depended on the time during which the point was pressing against the paper. A very weak current gives sufficient force to lift the light strip of paper, and press it against the disc firmly enough to receive a good impression, and consequently the relay and local circuit, used with the old embossing instrument, can be dispensed with in most cases.

This useful instrument seems to be a sound practical improvement on the old form; it substitutes direct for indirect action, a distinct for an indistinct record, and, at the same time, saves battery power. It is now used to the exclusion of all other forms by the French Administration. The invention of the first successful ink-writer of this kind is generally ascribed to Mr. Thomas John, a Hungarian.

The particular manner in which the disc of these instruments receives the ink, admits obviously of many variations, and may probably be from time to time considerably improved. The original form—that of a moistened felt-roller—has several defects; the roller has frequently to be changed, and is apt at one time to be too wet, and at other times too dry, and, if unskilfully managed, soils the paper and the clerk's hands.

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit two modifications, one in which a little bottle has a porous stopper resting on the disc, and a second which seems greatly superior, having the disc half immersed in a trough of ink, which is kept at a constant level by tilting more or less a large reservoir. An adjusting screw enables this to be done gradually and accurately. The little disc as it revolves in this trough is always equally wet, and the operation of refilling the reservoir need not cause either dirt or delay. In this arrangement the armature moves the disc up against the paper, instead of lifting the paper up to the disc. The disc receives its independent motion of rotation through a double swivel joint at the end of a long axis.

The point of chief importance is the independent rotation of the disc in the direction opposite to that which the contact with the paper would produce; and this peculiarity is common to all the forms hitherto mentioned. It is this rotation which in all these forms keeps the edge in a constant, or nearly constant condition, both during the transmission of signals, and during any pause or interruption.

Messrs. Digney, M. (France, 1,414), exhibit another modification of the Morse instrument, in which, instead of the polarized Siemens electro-magnet, the armature is arranged as in the relay already described, under the name of Système Melloni. In one of Messrs. Digney's instruments the coils round the relay are subdivided, and can be used in series or multiple arcs, so as to be adapted for shorter or longer circuits by the alteration of its resistance.

E. Tyer (United Kingdom, 2,977) shows two Morse ink-writers. In one the ink is supplied to a little nipple on a tube over the paper from a reservoir above it, flowing through the tube past the nipple, and down into a second reservoir. The paper is marked when pressed up against this nipple, but the hole in the nipple is too small to let the ink run out, except when the paper is pressed against it; the constant current flowing past the nipple keeps it from clogging. When the upper reservoir is empty, the two reservoirs are turned round, a fresh nipple is presented to the paper, and the ink flows back into the first reservoir.

The second ink-writer has a disc supplied with ink from a saturated cloth, which never leaves the disc, and therefore keeps it always moist; the disc has not the independent motion of rotation which is, in the writer's opinion, necessary to keep all points of its surface equally inked at all times.

M. Hipp, M. (Switzerland, 156), exhibits a telegraph receiver of novel construction, designed with a view to obtain increased speed of signalling with less battery power, and without the use of relays. He proposes to use what we have called the Steinheil alphabet, recorded on a slip of paper by two rows of embossed dots.

The peculiarity of the instrument consists in the fact that the strength of the electric current has no influence whatever on the force or rapidity with which signals are printed. The current received releases one of two armatures, the attraction of which to their respective electro-magnets is almost exactly balanced by adjustable springs. One armature is freed by a positive, the other by a negative signal; their movement releases a catch, whereupon the clockwork prints the required dot, and replaces the armature with extreme rapidity. The key for the operator is arranged as in a pianoforte, and a letter is sent by depressing a certain number of keys at once, as in playing a chord.

There can be no doubt that the arrangement of the receiver will allow great rapidity and force of action to be combined with excessive delicacy. The limit of the delicacy of adjustment is determined by the variation in the residual magnetism left after a succession of positive or negative signals respectively. M. Hipp considers that 180 letters can be sent by hand with this instrument, and there seems no reason to doubt this, judging by the performance of the clerks with Sir Charles Bright's acoustic telegraph.

(To be continued.)

ELECTRIC AND COSMICAL.

WE extract the following interesting observations from the *Weather Book* of Admiral Fitzroy, F.R.S., with the view of affording our readers an opportunity of discussing the questions raised:—

Electricians are familiar with "*circuits*"—completed circuits; and will probably think a person who asserts that *a circuit may be fallacious*, only proves his utter ignorance of the subject.

Undeterred, however, by this probability, the author attempts now to show that such theories are insufficiently supported by facts, and that the effect called "completion of a circuit" is caused in a manner altogether different, and hitherto unexplained. It is well known that communication existed for a short time between Valentia and St. John's, in Newfoundland, *under* the ocean, through a wire, or combination of wires, some 2,000 miles long; and very lately telegraphic messages were sent from London to Corfu, also

about 2,000 miles, in less than two seconds. In both cases the accounts allude, or rather refer explicitly, to the *return currents* of electricity—supposed to traverse the earth, through land and under sea, from one extremity of each great distance direct to the other—to "complete the circuits."*

To suppose that electricity darts from one point to another, immensely distant, rather than to any other much nearer recipient, at least *equally ready* to receive it, is a strain on imagination not easy to be borne.

The writer of these words has never been able to believe that such is the case, and now will offer a few considerations.

1. He has thought that electricity may be an etherial *influence*—not tangible or ponderable like any material fluid.

2. That space may be filled with such an influential ether, *infinitely elastic* and self-repellent.

3. That dry air is almost a non-conductor of its action.

4. And that *our* earth may be a vast reservoir, abounding in electricity—always ready to receive from space, while equally so to communicate to any point on earth's surface which may be less electrified than earth itself, and connected with it by a conductor.

5. Electric influence (or ether) may be cold, proportionately to its less resisted *expanse in space*.

6. Heat may be caused by compression of electricity (etheric influence), or by resistance to its expansion.

7. Matter in space, *acted on from every direction* by infinitely compressing *influence*, may become concentrated and heated, then develope a non-conducting atmosphere, and may acquire rotation in consequence of alternations and oppositions of electric influence within and without such an atmosphere, caused by heat acting against cold.

8. Under such conditions, any communication through *air*, by a *conductor*, upward or downward, from earth or from above, would facilitate electric action, which is invariably from the more electrified or influenced matter—to the less influenced—or, as *usually* said, from positively electrified to negatively electrified; the *direction* of action being unimportant, *supposing that one influence only* exists, which pervades all space, and is latent in all matter, in greater or less degree.

To go now into *reasons* for these suppositions—strange, even absurd, as they may appear to some persons unacquainted with Higgins's views,† with Faraday's expressions about gravitation, and with Newton's questions as to the real nature of gravity—would be unadvisable. The author ventures to write them here only to show why he believes that effects of the commonly received "circuits" of electricity may be more naturally and intelligibly explained in the following manner.

Whenever an electric effect (*usually called a current*) is to be caused through a conductor, *influence* must be generated, and accumulated by a battery, coil, or machine; and near each end of the conductor, however long or short, a wire must be "*put to earth*." The popular idea is that a current flies through the conductor, and returns through the earth. But the real effect, it is here submitted, is that earth *receives* influence sent along a conductor, and at the *same* time imparts equivalent influence to the battery end of the conductor, without which distinct and unconnected actions there could be no more transmission of electric influence along a wire than there could be of water along a pipe of which the farther end were closed, and a *vacuum* caused by any motion of fluid from the nearer end.

Imagine 10,000 inelastic, say adamant balls touching each other in a very long inflexible tube, *just* containing them in one direct line. Suppose the nearest struck sharply, all would feel and move, but *only the farthest* would drop out—though not even then, if a *vacuum* would be caused by displacing the *nearest ball*. The popular idea of flight, as it were, of electricity—fluid or something else—from one end of a conducting wire to the other, has usually been inseparable from the thought that *particles* actually traversed the whole length, however long, through or along the metal, instead of exactly considering and fully appreciating the action of a *conductor*, through air (a non-conducting medium) or in water if sufficiently insulated—by which an electric influence can be *connected or projected*—as action of a magnet on iron filings can be conveyed through an indefinitely long wire, though that magnet would not affect them, through air only, at a few inches distance.

But the author does not deny the *appearance* of circuits caused by closing, or approximating the ends of *any* conductor, *however long*, which are actually brought near, or to touch each other. He only ventures to deny the *transfer of particles* from sender to receiver—*as in the other case*.

Electric influence seems to act similarly to its correlatives, magnetic attraction and repulsion, which afford the least complex illustration of such a mysterious power acting in *lines of force*.* And where non-conducting air is *absent—as in space* beyond our atmosphere—who can say how far such influential forces may be always operating on our world—and, if so, on the universe.

Pervading all *space*—permeating all aeriform, gaseous, liquid and solid bodies—an *influence* seems to exist, ambiguously mentioned, rather than explained or defined, by the term Electricity.

Between this influence and caloric, and ether, and light, and magnetism, so close are the connections or correlations, and so indefinite are any even imaginary limits, that no man now can discriminate accurately where one merges in the other, or prove to demonstration whether each such apparent or sensible, though imponderable element, may not be but a condition or modification of *one etheric principle*.

Facts seem to indicate that such a principle (for brevity here called *etheric* and referred to by the familiar term ether) must be very elastic and *self-repellent*, but attracted by matter to a certain degree—namely, the point of saturation.

Cold when expansive, hot when compressed, its cosmical tendency would seem to be concentration of ponderable matter, development thence of heat and generation of atmosphere.

Earth's aeriform envelope, *almost* saturated with (the *influence* here called) ether, may be *slow* to receive *more*, or to part with any; therefore, with respect to *infinite* space, and to our relatively central earth, may be considered as nearly non-conducting—in fact, a very slow dielectric.

If all matter retains a certain quantity of *latent ether* (rather than caloric), pressure, compression, friction, impact, or contact, may cause augmentation of sensible heat, proportionate to force or duration, or both together.

Conversely—inaction, expansion, evaporation, or radiation, may cause cold, in proportion to their degrees.

Ether, from or in space, may be cold. That in earth, heated by compression and *considerably* more expansive or elastic, may always *tend* to escape, but is enclosed by our atmosphere. Hence the readiness of *earth ether* (*excessive* electricity) to replace any void in air (caused by voltaic or other electric agency), and the constant necessity of such an *extra force*, to impel a so-called current along a wire *into* the earth beyond.

The heated ether of earth may have been *known* by the terms negative, resinous, or minus electricity—although such words seem now to indicate one and the same state or condition of a principle, or influence, that varies in equilibrated tension according to circumstances—certain temperatures, states of matter, and *relative* expansion or compression.

Atmospheric currents seem to be electrified (or *etherised?*) *differently*, when proceeding *from* the torrid zone, as compared with their state while coming from a pole. And their inter-action, or friction, in crossing, *super-passing*, or otherwise affecting each other, may cause electro-magnetic "*earth-currents*," or telegraphic "wire disturbances," notwithstanding that such phenomena are found to occur rather before any considerable changes of air-currents (winds), whether from tropical to polar, or the contrary, are noticed. These changes are not necessarily violent; on the contrary, they are sometimes so gradual as to be scarcely remarked by general observers; but no important change or alteration of wind happens (as far as the writer is yet aware) without some of these remarkable supposed indications of such aerial collisions.

Auroras and "*magnetic storms*"—or disturbances of magnets at observatories †—have been noticed as synchronous with earth currents along telegraphic lines; and it is, at all events, a popular belief that strong winds usually follow auroras.

In Great Britain the action of a polar current is shown by "deflections," and other disturbances, chiefly along the wires that run eastward, and to the north, from London. Deflections on the western and southern lines (*from* London) *seem*, as yet, to indicate appulse of a tropical air current—principally.

Deflections (so called), on all lines, show general disturbance of the atmosphere, by collision of currents, and are premonitory.

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* Such a length—or the *interval* between *any* two stations—may be well termed a *span*?

† Comparative View, Second Edition, 1791; and his Atomic Theory.

* Faraday.

† C. V. Walker, and Balfour Stewart, F.R.S., in Phil. Trans., 1861 and 1862.

These occasional, but apparently *periodic* effects, seem to be closely correlated to those aerial overflowings in the torrid zone which have been described in the eighteenth chapter of this book.

Suppose that *continuous* streams are caused from upper tropical regions toward each pole (as there expressed), and with return currents from the poles, such horizontal and derivative motions would increase, decrease, or vary, like tidal *currents* occasioned by great tidal elevations or depressions. "A continued stream may be produced by a succession of impulses, as a rotary system of waves may be kept in constant circulation by impulses received from the adjacent tides."*

If these views are based truly, and are legitimate inductions from facts, *Solar action* may be shown to vary in its *effects*, during a certain number of years, in addition to those ordinary consequences of annual changes exemplified in seasons.

May not *decennial*, or other variations of solar causation,† be traced indirectly, if not, indeed, directly, by prolonged observations of these mysterious currents—already referred by some philosophers to *temperature* within the earth,‡ or, by others, to the direct action of our great luminary?

Seeing that impulsion, or forcibly sudden impact, causes heat, if not also fire, may not *prolonged* compression induce slow combustion, as effect of ether and oxygen?

Polar currents of *cold* air, much etherised, may have an excess of plus, vitreous, or positive electricity, Tropical (*warm*) ones may be minus or negatively electrified? Or conversely?

In regions where *extreme* atmospheric qualities approach, or meet—as in or near the tropics, where air and water are much heated—while *space above* remains cold, and where mountains reach to a climate cold even in summer, lightning and thunder-storms are very frequent.

On the other hand, in the icy high latitudes of polar regions very seldom is thunder heard, and rarely is lightning seen.

But the aurora is *very* frequent, and at times has *seemed* to be near, even close,§ as if within a few miles.

May not auroral exhibitions, so beautiful, and occasionally so *extensive*, *though synchronous*, be caused by *inter-crossing* currents of air that develope electric (or etheric) light in our atmosphere, chiefly where it approaches space, is incessantly whirled round as earth rotates, and is separated, while confined, at its *cold* outer limit?

What an electrician can effect in a room, by a machine and exhausted receiver, may surely take place, on an immeasurably greater scale, in atmosphere, or in the *comparative* vacuum near its outer limits.

Cold air, in polar regions, having much ether (or electricity), any friction, of inter-crossing air currents or otherwise, may cause its ready development.

Are not the working of an electric apparatus, rubbing a cat's back, combing hair, or even the harshness of one's skin, familiar evidences of a state of air extremely different from that which accompanies a tropical current of wind.

Ozone is prevalent with tropical winds, especially near the sea; but it is not so with polar wind, unless a temporary and merely *returning* current of tropical air.

"Northern Lights," "Merry Dancers," "Streamers" of various bright colours, at times almost blood red—illuminate the polar regions, are sometimes seen in the middle latitudes, and, though rarely, near the tropics.

Cold—excess of ether or electricity, dry air, and an upper, or *commencing* contest of aerial currents, seem to be invariably present when aurora is conspicuous.

The magnetic influence of ether (in electro-magnetism) is extremely remarkable—so little need there be of a merely *material* connection between a magnet in air, and iron or steel which it affects. That magnetic (electric or *etheric*) influence is not stopped, or entirely cut off, by glass, is shown by the action of a magnet on the steel index of a Sixe's self-registering thermometer; or by a compass needle, entirely surrounded by a hollow glass sphere—and in other experiments.

The attraction existing between electric ether and iron seems to be felt *similarly* to that of our earth and ether in space, although in an immeasurably less degree. In each case, as supposed above, a dielectric, already saturated with ether in a latent state, is interposed—whether glass, or the atmosphere.

Imponderable electricity, or ether, has had its *effects* weighed by a delicate balance* and its velocity measured† mathematically as well as practically.‡ Apparently diffused everywhere in and through every kind of material, perhaps throughout all space—surrounding closely and actually separating molecules,§ if not atoms, even *ultimate particles* of matter—it may be admitted to be the *principal agency* that is traceable in all our mundane if not in all cosmical operations.

Nevertheless, it is unquestionably a mere instrumental means. It has not been proved to affect anything except by such ordained laws as can be partly traced by man. It does not act till forced by some change of condition—of temperature—or of equilibrium:—and, for our beneficial use, it is sufficiently within human control.

* Whewell, Phil. Trans., 1836, p. 299.
† Schwabe, and Sabine, Pres. R.S.
‡ Airy—Astronomer Royal.
§ Ross's Arctic and Antartic Voyages—Scoresby, and others.

* Snow Harris. † Thomson. ‡ Wheatstone, and others.
§ Higgins—Atomic theory.

REPORT OF THE TELEGRAPH CLERKS' PROVIDENT FUND.

THE Committee have much pleasure in submitting their Balance Sheet for the information of the members of the Telegraph Clerks' Provident Fund. Considering the short time that has elapsed since its formation, the progress and position of the fund must be considered most encouraging and satisfactory. The liberal donations which have been received, chiefly from those more or less connected with Telegraphy, and their consequent interest in the welfare of those who are dependent on that service, have enabled the Committee to invest £184. 2*s.* in the purchase of £3. per cent. consols to the value of £200; thereby forming within a few months a solid, and, it may be hoped, accumulative foundation for the future stability of the fund.

The annual subscriptions already promised, independently of sums to be received from members, amount to £55. 12*s.* 6*d.*, the greater portion of which have been received and invested as above.

The only liability beyond the current claims of members, is for the Stationery Account, Books of Rules, &c., the chief portion of which goods are still in hand, and available for the future working of the fund. It will be seen that the cash at the Bankers is more than sufficient to meet this liability.

It might have been reasonably expected that the establishment of the fund would be a work of time, considering that those for whose benefit it has been introduced are scattered over all parts of the kingdom, and possibly have not previously considered the general benefits of belonging to such a society. The Committee have, therefore, much satisfaction in stating, that although the fund has only been in actual operation since October last, it now numbers seventy-one members, composed of clerks and employés in the service of the Electric and International, the Magnetic, the United Kingdom, and the London District Telegraph Companies.

Several applications have also been received for information, Books of Rules, &c.

It should, however, be borne in mind, that the earlier members join, the greater permanent advantages they get by a reduced rate of subscription.

The Committee are glad to be able to report, that up to the present time the claims have been limited to two, and these are on the Sick Fund.

They also think it right to state, that Dr. Sutro, of Finsbury-square, has kindly consented to act as Honorary Physician; and that, through his introduction, Messrs. Baumgarten, of No. 520, New Oxford-street, and No. 113, Leadenhall-street, have undertaken to prepare his prescriptions for any members of the fund at cost price.

The Directors of the London District Telegraph Company have also kindly granted the necessary office accommodation for conducting the business of the fund gratuitously.

In conclusion, the Committee believe that they can safely report, that there is every prospect of the society assuming the position for which it was originally intended—viz., a Provident Fund for the present and future benefit of those in the employ of any Telegraph Company.

REPORT OF THE DIRECTORS OF THE SUBMARINE TELEGRAPH COMPANY.

THE annexed account for the half-year ending 31st December last, exhibit a satisfactory and steady increase in the Company's revenue.

The receipts for the past half-year, derived from 185,380 messages, amount to 25,184*l.* 1*s.* 2½*d.*; for the half-year ending 30th June, 1863, from 160,404 messages, 22,144*l.* 2*s.* 8½*d.*; and for the half-year ending 31st December, 1862, from 172,881 messages, 23,427*l.* 5*s.* 6½*d.*; while the ordinary working expenses remain nearly the same.

Since the last meeting of shareholders a considerable reduction has been made by the different administrations in Germany in their internal tariff, which, it is expected, will cause a still further increase in the traffic.

Owing to the prevalence of the unusually tempestuous weather during the autumn of last year, several of the cables suffered, unfortunately, considerable damage, and have burdened the revenue with a much larger expenditure than usual for repairs. Notwithstanding, however, this additional outlay, the Directors are enabled to recommend a dividend, at the rate of 4 per cent. per annum, although the capital has been largely increased by the issue of the new stock; to add the sum of 2,518*l.* 8*s.* 2*d.*, being 10 per cent. on the receipts, to the reserve fund (which will then amount to 6,441*l.* 7*s.* 0*d.*); and to carry over 774*l.* 13*s.* 9½*d.* to the next account.

It is with great regret the Directors have to announce the death of their lamented colleague, Mr. John Watkins Brett, who was one of the originators of this undertaking and to whose labours the world is mainly indebted for all the benefits arising from the establishment of the Submarine Telegraph.

Two gentlemen of much experience in the management of Submarine Telegraph Companies have declared themselves candidates for the office of Directors; one of them, the Right Honourable James Stuart Wortley, is the Chairman of the Atlantic Telegraph Company, and the other, Henry Moor, Esq., M.P., Chairman of the Mediterranean Extension Telegraph Company, and the Directors would, therefore, be glad to have their valuable co-operation at the Board.

In conclusion, the Directors have to mention the resignation of Mr. Courtenay, after twelve years' service as secretary, in consequence of his accepting an appointment under Government, in connection with the Indo-European Telegraph. It is with much pleasure that the Directors can bear testimony to the zeal and ability he invariably displayed in the discharge of his duties, and while they regret his loss, they consider that they have been fortunate in appointing Mr. Clare as his successor, who will still retain the same superintendence of the accounts as he has hitherto done.

CORRESPONDENCE.

TELEGRAPHIC FEATS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Your correspondent, "W. H. N." of last week is evidently a "magnetic man," and whilst professing to do justice to the double needle and Morse, he puts the Electric and International Telegraph Company's ordinary single needle instrument entirely in the shade, and enlarges upon the superiority of Bright's bell and single needle systems.

I quite agree with "W. H. N.," that a good manipulator is the best judge of the working qualities of any telegraphic instrument, and that those who are not qualified in this respect are too apt to be led away by the opinions of individuals who are interested in some particular system; but my experience in the working of the Electric and International Telegraph Company's ordinary single needle instrument warrants me in protesting against the assertion "that its construction and code makes it slow and uncertain, and that the maximum speed attainable is only about fifteen words per minute." The single needle instrument is constructed on precisely the same principle as the double needle, and the alphabet and code employed is precisely the same as for the Morse. In the north of Scotland the single needle is the chief instrument in use, both for railway and commercial purposes; and I believe ample proof is obtainable that twenty-eight to thirty words per minute is a common speed for the transmission of expresses, &c. The Queen's Speech—of the transmission of which on all the existing systems, excepting the single needle, so much has been said in your Journal—was forwarded to two stations on one circuit, neither giving "understand," at the rate of twenty-seven words per minute, and this without taking into account numerous stoppages from various causes. Your correspondent's knowledge in this department of telegraphy must therefore be more limited than his letter leads us to infer, and I hope he will take the trouble to extend his researches in the right direction, and gratify us with the result through the medium of your Journal.

I know something of most of the telegraphic instruments now in use by the different companies; and, after a careful consideration, have come to the conclusion that the Morse, with Varley's pecker and relay arrangement, is second to none; and that if the ordinary single needle instrument was more generally used, it would take its stand next to the Morse, not only on the score of economy, but for all the qualities requisite in a commercial telegraph.

The insertion of these remarks in your next issue will, I am sure, confer a favour on all experienced single needle and Morse clerks.

Scotland, Feb. 29, 1864. FAIRPLAY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Having perused your Journal of week ending 27th February, I observed a paragraph headed "Telegraphic Feats;" and in this paragraph the single needle instrument is represented to be a very slow and uncertain mode of telegraphy, and also that the maximum speed does not exceed over fifteen words per minute. I myself, having had a number of years' experience in working both this and other instruments which the Electric Telegraph Company use, beg to express my humble opinion on the subject. I consider the single needle instrument a very valuable one; and, if well manipulated, can do a great deal of work. The whole of Scotland, north of Aberdeen, is principally worked by this instrument, and it is remarkable with what rapidity the news is transmitted. The Queen's Speech was transmitted from Aberdeen to Inverness—a distance of more than 100 miles—at the rate of thirty words per minute, not accounting for stoppages by minor stations on the same circuit, and this is about the average speed which all news is sent.

As to the construction and code of the single needle instrument, I can only say they are very compact and simple, and, owing to the alphabet being the same as the Morse, renders one clerk after a little practice capable of working the two instruments.

Should you deem this worthy of a corner in your valuable paper, it may be interesting to some single needle clerks.

I am, yours obediently,

Aberdeen, March 1st, 1864. BON ACCORD.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I must apologise for encroaching upon your space again, but allow me to say a word or two in answer to the erroneous impressions your correspondent "W. H. N." possesses, and desires to communicate to others, upon the capabilities and merits of the Morse instrument.

He condemns the instrument because confusion is likely to result through blundering clerks. Everybody must instantly see that no instrument can possibly render correctly at one end of a line anything incorrectly sent from the other. No one could pretend that the Morse, or any instrument in fact, can make a bad clerk a good one.

This, however, is less likely to cause bewilderment on the Morse than on needles or bells, because bad writing may be deciphered if carefully scrutinised, while anything indistinctly *spoken* (as with the bells) and not understood, is lost or must be repeated.

I am afraid "W. H. N." has never seen a Morse instrument; at any rate, he understands nothing of the principle, or he could not have made such a mistake as he has done by saying,—"A yarn must be finished before the sender can be stopped."

A clerk sending a message can be arrested on the instant; in this respect the Morse is upon the same terms as the bells.

Why is conversation more impossible with the Morse than any other instrument? Any visitor who has been in an office where the Morse is used must have been struck with the rapidity of exchange of questions and answers. The maximum speed of the bells is fifty words per minute, yet ordinary and every day news is only received at the rate of thirty or thirty-five words per minute,—when, then, is the maximum attained? not in the passage of messages, I am confident.

The advantage of the Morse is that a good uniform rate of transmission can be maintained, whether for news, messages in any language or cypher, because, as I stated at first, you have the recorded signals before you to look at again and again, ensuring greater certainty of the correctness of every communication, and this is required more than a great speed on occasions only.

"W. H. N." should bear in mind it is necessary to be well informed upon any matter before one is in a position to criticise, for this reason his letter is not impartial; and as it does not contain facts, it of course fails to be instructive.

I am, sir, your obedient servant,

OLD DOUBLE NEEDLE AND MORSE CLERK.

Dover, March 2, 1864.

THE INDIAN TELEGRAPH.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—I beg to enclose to you, with the desire they may be published, statements which I have received from Bagdad. My informant is now superintending the erection of the new Indian telegraph between Bagdad and Hilleh; he is a gentleman well known in the police services of India, and I am sure his statements may be fully relied on. The conduct of those he complains of being of some importance towards the ultimate success of the telegraph itself in that section of it, I trust you will think proper to insert the accounts in your next issue, or when convenient, a favour I respectfully beg.—I am, sir, your obedient servant,

12, Denbigh-road, Bayswater, Feb. 29. HENRY EVENNETT.

"NEW INDIAN TELEGRAPH.—*How the Turkish Government Pays and Discharges the Labourers employed by them in erecting the New Indian Telegraph between Bagdad and Hilleh.*—On the 21st of December last the paymaster appointed to pay the workmen erecting the Hilleh section of the telegraph, being short of cash, locked about forty of the poor creatures in a dirty room in the Khan. After leaving them some time in close confinement, took them out one by one, cursing their fathers, mothers, sisters, and wives; and by way of showing them his authority, &c., struck them from fifteen to twenty blows on their heads, elbows, and legs. The poor things fled—leaving, some two, some three, others four days' pay behind due to them. This mode of paying and treating the poor in the neighbourhood of Bagdad is quite common. The paymaster's name is Emar Effendi, who is a tool in the hands of Bekeer Effendi, and one or two others, the whole of whom are favourites of the Governor of Bagdad. It is thought the infamous conduct of Emar and Bekeer Effendi towards the Arabs along the route will make it useless to effect the Hilleh section for the present. Mr. Perceval, who was on the Hilleh section, has been called by the Resident at Bagdad to Busrah. As long as the Arabs thought that the telegraph was English there would be little danger from the Arab tribes, owing to the popularity of Colonel Kemball among them; but the Turks, who are jealous of the great influence of the English among their persecuted and oppressed Arab subjects of Mesopotamia, having lately published that the telegraph was the property of the Sultan, the Arabs, when they think they have been unjustly treated by the Government, will on the first opportunity destroy the line. The only chance there is for the British Government is for Englishmen to be employed to look after the line when completed, and these Englishmen should be paid by the British Government, and be placed under the orders of the Resident at Bagdad. Subsequent information received states that soon after the departure of Mr. Joyce Perceval for Busrah, an Arab tribe of over one thousand horsemen—learning from their oppressed brethren of the town the treatment they had received, and believing the telegraph to be the Sultan's property—came down and destroyed everything, stole the tools, robbed the remaining men of their money and clothes, spearing many of them, some of whom have since died of their wounds. About fifty mules were taken, as well as the tents and material required for the erection of the line. Mr. Perceval's mule, carrying his kit and bed, was alone spared, as an acknowledgment of the kindness he had shown and the protection he had afforded to the poor Arab labourers under their grievances. Many of the poor creatures were daily beaten by the officers sent to pay them, in order to induce them to run away from the work and leave their pay behind. Their friends have in the way stated taken up their cause against the Turks, to the great damage and delay of the completion of the line, as well as to the loss of the British Government."

THE TELEGRAPH CLERKS' PROVIDENT FUND.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—In reply to "A Shareholder," whose letter appeared in your last impression, I beg to enumerate a few of the arguments adduced at the meeting of the Magnetic Company's employés, with the principal objections taken by them, to the rules of the "Telegraph Clerks' Provident Fund."

In the first place, candidates for membership are required "to produce a certificate of birth or baptism, and to state whether they have ever been afflicted with small-pox, or been properly vaccinated; if had the measles, or the hooping-cough; if had any serious illness—if so, stating the nature of such disease; and whether of temperate habits." Also, "whether candidate believes he, or she, is in good health or liable to any disease." "Whether any near relation has died of consumption, or been afflicted with insanity, &c. &c." The medical officer has also to inquire "if the candidate has any ruptures, wounds, or tumours; or whether he, or she, has ever been afflicted with acute disease of any kind, or subject to gout or rheumatism." Also, "*the age of parents*—if alive—if dead, *the cause of death; number of brothers or sisters; how many have died, and of what diseases*, and whether any relative has died of pulmonary consumption."

The arguments brought forward against these rules were, that they alone would exclude many clerks from becoming members, who would be eligible for other societies.

Rule 2 states, "that patients *must find their own bottles, &c.*, necessary to contain their medicines; and those whose diseases do not confine them at home are expected to attend at the houses of their respective surgeons before ten o'clock in the morning."

Almost any surgeon in the kingdom gives advice gratis to any person attending at his residence before 9 A.M.; and by attending at any hospital, and *taking their own bottles*, patients receive advice and medicine gratis; yet for this, and 10s. per week—not sufficient to live upon, let alone obtain the extra comforts usually required during illness—the "Telegraph Clerks' Provident Fund" require 3½d. per week, in addition to the member going through several unnecessary and humiliating formulas—such as "producing certificates of baptism, getting the medical certificate signed by a magistrate," &c. The munificent sum of 2s. 6d. per week, in lieu of medical attendance, is allowed to those who reside in a district to which no medical officer is attached.

The chief medical officer resides in Finsbury—a place no doubt selected because it is within half a-mile from the society's offices; whereas the majority of telegraph clerks reside two, three, and four miles distant. By this arrangement a saving to the fund is effected, as no medical advice or medicine can be obtained, if the illness is at all serious, for 2s. 6d. per week.

Rule 7 requires, "that the certificate for claiming sick pay must be signed by the minister of the parish in which the member resides, or by a magistrate, and is to be repeated every fortnight." In the name of common sense, can anyone say what the minister or magistrate, unless personally acquainted, knows of the illness of any individual person, let alone a telegraph clerk, who is invariably "a boarder or lodger." Such a rule as this is, I maintain, simply preposterous.

Rule 9 excludes from receiving sick pay "all members suffering from illness caused by *having been engaged in any games or sports*, nor on account of insanity, slight paralysis, blindness; nor to any female member, married, by reason of any sickness or illness the result of childbirth, or any disease consequent thereon."

With regard to the first paragraph of this rule, it must be apparent to every right-minded person that it will be greatly detrimental to the fund obtaining *male members*, inasmuch as they will think themselves debarred from enjoying the noble game of cricket, the exhilirating sport of running or jumping, the manly exercises of the gymnasium, or any healthy, and yet dangerous, recreation, so necessary to man after being shut up in a hot office for eight to ten or twelve hours—because they, the members, would be in constant fear of being hurt, and excluding themselves from receiving any benefit from the fund, which would thus leave them to starvation and pain.

With regard to insanity, slight paralysis, or blindness, I am of opinion that, when a member became afflicted with either of these calamities, the fund shall then grant the benefits so painfully needed by the poor telegraphist, who is thus doomed to life-long exclusion from society. The next consideration in this *beneficial rule* is the clause relating to "married female members and childbirth." The employment of females in telegraph offices having only been commenced but a few years since, very few have, up to the present, entered into the happy state of matrimony; but for those who are about to do so, what a consolation it is to them to know that, if they join the fund, and continue in it after marriage, with their husband's consent, they will not receive any sick pay should they experience "the great danger of childbirth." Why, sir, this is the very time they would need assistance, especially if their husbands are telegraphists—and why should it be withheld from them? This requires explanation, and many of our married clerks anxiously await it.

By rule 11, any member who has been ill and receiving sick pay for three months, is able to return to duty, and in three weeks, or less, is taken ill again, is excluded from receiving further relief until six months has expired.

I am at a loss to know where we shall find rules of a more technical, complicated, and exacting nature than the foregoing.

"A Shareholder" seems only to have taken into consideration that clerks under 20 years of age, by paying 3½d. per week, receive 10s. per week and medical attendance (or 2s. 6d. extra) in sickness. He has not considered the harass and bother of getting certificates signed by magistrates or clergymen, producing registers of baptism, &c., for the purpose of receiving the said benefits.

Some of our clerks belong to societies where, by paying 1s. per week, are allowed 18s. per week in sickness; £2 *at the birth of every child of which the member is the father*; £15 in case of fire at the member's residence; £10 at death of member's wife, and £20 at his own decease; £5 also allowed for a substitute if the member is drawn for the militia or special constable, and numerous other benefits. This refers to the "Royal Standard Society." Nearly all other societies allow a sum not under £10 for the death of the wife of a member.

With regard to the observations of "A Shareholder," that "it is to be feared that this unfortunate resolution on the part of the meeting is only another instance of the senseless jealousy and rivalry existing amongst the employés of the various companies," what will he say to the fact that "out of about 150 or more employés of the "London District Telegraph Company" (at whose offices the "Telegraph Clerks' Provident Fund" is established, and therefore more immediately belonging to them), only 60 or 70 have, up to the present, joined the fund.

This is convincing proof that the "fund," not being held in high estimation by the majority of telegraph clerks, is not due to the *senseless rivalry, &c.*, but to the want of those benefits for which the society was instituted, and towards the payments of such benefits so much money has

been given by benevolent persons, at the head of whom we must now place Her Royal Highness the Princess of Wales, interested in the welfare of telegraph clerks.

Believing "that the technicalities and requisitions introduced in the rules of the Telegraph Clerks' Provident Fund" debar the members from receiving the benefits anticipated from the nature of such a society, the Magnetic Employés Meeting passed the *unfortunate resolution* referred to by "A Shareholder."

What we require is, that the rules shall be thoroughly revised; the numerous technical points and *absurd requisitions*, at present introduced into them wholly withdrawn, and a trifling higher subscription to be paid for greater benefits to be received when members are laid up by illness, no matter from what cause it arises, excepting, of course, diseases contracted by profligacy, or members' self-neglect. When this is done, I have no doubt that the numerous patrons and patronesses of the fund will find their laudable efforts to ensure relief to the many needy telegraphists eventually crowned with success.

Trusting I have explained the rules sufficiently to allow you, Sir, to form a conclusion that the meeting was right in passing their resolution,—I am, Sir, yours very faithfully,

G. C. NEWBURY,
Chairman of the Magnetic Employés Meeting.

58, Threadneedle-street, March 2, 1864.

TELEGRAPHIC NEWS.

GOVERNMENT TELEGRAPHS.—In reply to Mr. D. Griffith, on Tuesday last, Mr. Layard stated that telegraphic messages received in cypher are never printed, while those received in ordinary words are included in the returns.

THE TELEGRAPH BETWEEN EUROPE AND AMERICA.—We understand that Her Majesty's Government have granted the concession of a right of way through British Columbia, for an electric telegraph to connect the existing United States lines with those to be extended from Russia, across Behring's Straits, a concession for the latter portion of this line having previously been given, by the Russian Government, to Mr. Collins, an American citizen.

TELEGRAPHY IN MEXICO.—The French Government are dispatching a large staff of experienced officers and engineers to Mexico, to construct extensive lines of telegraph, for which the materials are also being shipped.

THE UNIVERSAL PRIVATE TELEGRAPH COMPANY have introduced their system of communication into Belfast, a town which, from its large manufacturing establishments, cannot fail to derive much benefit from so cheap and speedy a means of communication. The system is similar to the one carried out by the company in London, Manchester, Glasgow, and other large towns. The works and lines were erected by Messrs. Reid Brothers, of the Telegraph Works, Wharf-road, City-road, London. The system is to be introduced into several other towns in the United Kingdom.

WE are sorry to hear that the Emden cable, belonging to the Submarine Telegraph Company, has been injured, as it is supposed, by a ship's anchor. Arrangements have been made for its speedy restoration, by Mr. J. R. France, the company's engineer.

THE UNITED KINGDOM TELEGRAPH COMPANY having opened their Northern Trunk Line to Newcastle, Sunderland, and Stockton, which joins on to their other main lines ~~at Leeds, to London~~, Manchester, Liverpool, Hull, Birmingham, Wolverhampton, Bradford, and nearly all the principal towns in the south of England, will in a few weeks have finished other extensions to Edinburgh, Glasgow, Leith, and Scotland generally; also their extensions in the west of England, to Bristol, Cardiff, Swansea, Penzance, and other seaports. The boon being now extended to Newcastle, we feel certain that the company will be appreciated by the public, and general support given to it, so that the United Kingdom Company's lines may ramify through every town in the kingdom; and, instead of a telegram being an expensive luxury, it may become so well known and understood by all, that it may be resorted to by the small tradesmen, as well as large merchants, brokers, and others, and in fact become almost as necessary as the penny post. Some little excitement, and considerable amusement, was afforded by the three competing telegraph companies yesterday; for no sooner had the United Kingdom Telegraph Company announced their offices opened, than large placards were immediately posted in the windows of the high rate companies, announcing great reduction of tariffs to those towns in which the United Kingdom Company have offices, and small slips of green paper were issued *ad libitum*, intimating that, until "further notice," they would remit at the same tariff as the shilling company. What this "further notice" means, we leave to the public, satisfied that honourable competition will not only benefit the general public, but also the competitive companies. We can only trust the new company will meet with the support it deserves. The opening message of the new company was addressed to the Mayor, and was as follows:—"The directors of the United Kingdom Telegraph Company to the Worshipful the Mayor of Newcastle.—The directors of the United Kingdom Telegraph Company beg to announce the opening of their lines to your town, and, in the first message through their lines, beg to thank you for the valuable aid rendered by yourself and fellow-townsmen towards its accomplishment."—*Newcastle Daily Journal.*

REFERRING to our announcement last week of the opening of telegraphic communication between Cape and Graham's Towns, later intelligence represents the line as working admirably, and much used.

THE ATLANTIC TELEGRAPH COMPANY have given notice that the seventh ordinary annual meeting of the shareholders will be held at the London Tavern, on Wednesday, the 16th proximo, at one o'clock, p.m., for the purpose of receiving a report and balance-sheet from the directors, and for the transaction of the ordinary business of the company, and a full attendance of the shareholders is specially requested.

THE Electric Telegraph between Cape Town and Graham's Town has been opened to the public, and messages are now daily transmitted along the line. On the many advantages that this grand invention will secure to the colony it would be superfluous to comment.

THE CAPE TOWN AND WELLINGTON RAILWAY COMPANY have opened their line for the use of the public. The tariff of charges is very moderate.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities .	2/3 to 2/6 per lb.
Good re-boiled	1/7 to 1/10 „

INDIA RUBBER.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/6 „

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	104 to 107	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	½ dis. to par	—
10	Mediterranean Extension Tel. .	all	3½ to 4½	—
5	London District Telegraph Co. .	all	1½ to 2	—

TO CORRESPONDENTS.

DELTA.—It was not Mr. Reid that proposed the presentation of £1000 instead of the annuity of £300. It was Mr. Frazer who moved, "That in lieu of the proposed pension of £300 per annum to Mr. Fourdrinier, the sum of £1000 be voted to him," which was carried unanimously.

ONE OF THE LEAST.—Your communication is unavoidably postponed until next week.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street, E.C.; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)..................	0	3	0

Single Advertisements from the country must be accompanied with stamps in payment.

THE TELEGRAPHIC JOURNAL.

VOL. I. No. 11.—MARCH 12, 1864.

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THE TELEGRAPH TO INDIA.

IN a second edition of this Journal of last week we had the gratification of announcing the successful submersion of the most important and difficult section of the Persian Gulf telegraph cable, 359 miles in length, from Gwadur, in Beloochistan, to Cape Mussendom, on the coast of Arabia. It appears that Colonel Stewart and Sir Charles Bright arrived off Cape Mussendom at noon on the 9th February, and sent a telegram through the cable announcing the completion of the work so far, which reached Bombay at three p.m. on the same day. The cable is represented to be in excellent working order, and arrangements were being made to proceed with the remaining sections without delay, which consists of the section from Cape Mussendom to Bushire, a distance of 440 miles, with an average depth of 80 fathoms, and that from Bushire to Shat-el-Arab, at the head of the Persian Gulf, a distance of 170 miles, with an average depth of 25 fathoms. At Shat-el-Arab the cable will be joined to the land line to Constantinople and England, while from Meekran to Kurrachee the land line is completed. From Kurrachee communication can be telegraphed to Bombay, Madras, Calcutta, and even to the frontiers of Burmah. Of the vast importance of such a work in a political and commercial point of view it is impossible to form too high an estimate, and we believe that it is only a precursor to even yet more stupendous undertakings for the extension of the advantages of land and submarine telegraphy. Although it may be urged that the Persian Gulf cable is only laid in shallow water, and that its successful submersion does not imply the practicability of deep lines, it cannot be denied but that the practicability of conveying large masses of insulated wires to remote distances, through hot climates, has been fully established by the adoption of adequate precautionary means.

The following is a description of this important cable, and of the tests to which it was subjected:—It was sheathed at the works of Mr. W. T. Henley, in twelve No. 7 gauge hard-drawn iron wires, thickly galvanized, and then thickly coated with two servings of tarred yarn, overlaid with two coatings of Bright and Clark's patent composition, which consists of mineral pitch or asphalte, Stockholm tar and powdered silica, mixed in certain proportions and laid on in a melted state, which, when cold, forms a massive covering of great strength and flexibility, totally impervious to water, and, it is believed, incapable of being destroyed by animalculæ. The copper-conducting wire is composed of four segments, drawn into a hollow tube in such a manner as to appear like a solid wire, and was carefully selected for its high conductive capacity. The conductor, which is nearly one-eighth of an inch in diameter, was covered by the Gutta-Percha Company with four distinct coats of gutta-percha, and four coats of Chatterton's compound, laid alternately, after which the core was subjected to a pressure, in Reid's tanks, of 600 lbs. on the square inch, and carefully tested for insulation, and the exact condition of each mile recorded. The following is an extract from one of the books, in which each testing was registered:—

RECORD OF TESTS APPLIED TO CORE AT GUTTA-PERCHA WORKS, APRIL 10, 1863.

No. on Coils, 155; Length of Coil, 2172 yards; Weight of Coil, 523 lbs.; Difference of real from contract weight, per nautical mile, +0 −11 lbs.; Immersed in Water at 24° centigrade, 24 hours; Temperature of Room, 15° centrigrade.

Resistance of Conductor—
No. of Elements, 6; Ratio of Balance, 100; Observed, 7·35; Reduced, per nautical mile, 6·86.

Resistance of Dielectric—
No. of Elements, 504; Time of 10 Oscillations of Needle, 29 seconds; Before Pressure—Deflection after 1 minute negative, 2·0; Resistance, per nautical mile, mill. of units, 261. Under Pressure of 600 lbs. per square inch—Deflection after 1 minute negative, 1.7; Resistance, per nautical mile, mill. of units, 308.

Charge and Discharge—
No. of Elements, 47; Constant of Instrument, 3·4. Discharge after 1 minute's electrification—Observed, 15·6; Reduced per nautical mile, 14·57. Discharge after 1 minute's insulation, 8·6; Per Centage of Charge remaining after 1 minute's insulation, 55·1.

The sections of the cable left the Thames in the following vessels:—The *Marian Moore*, on the 17th of August, with 175 miles; the *Kirkham*, on the 7th of September, with 188 miles; the *Assaye*, on the 20th September, with 368 miles; the *Tweed*, on the 24th October, with 347 miles; and the *Cospatrick*, on the 16th of November, with the shore ends, completing the 1,240 miles manufactured, all of which had arrived at Bombay, with the exception of the *Cospatrick*, which, however had been spoken to, and probably has reached her destination by this time. All the vessels were furnished with tanks, in which the lengths of cable were coiled and covered with water, each ship being provided with a small steam-engine, for the purpose of emptying and re-filling the tanks from time to time; while on board of each vessel, batteries, resistance coils, and galvanometers were provided, for repeated testings on the outward voyage.

A small steamer, the *Amber Witch*, has been fitted up with all the necessary appliances for raising and repairing the cable in case of accident, and which will also be employed for supplying provisions to the various stations.

THE RAILWAY AND TELEGRAPH INTERESTS IN PARLIAMENT.

NOTWITHSTANDING that there is a capital of £450,000,000 invested in railway projects, all that appears necessary now-a-days, to ensure further investments, is an enterprising manager, a tolerably plausible prospectus, and advertising *ad libitum*. The public appear to be aware that no difficulty will be experienced in procuring a Bill for a railway anywhere, except through the centre of St. Paul's Cathedral, though we are not certain whether some of the more ambitious promoters of these schemes have not consigned this magnificent edifice, among other buildings, for demolition. The days of the metropolitan railway mania, however, appear to be numbered. A meeting of some of the most influential merchants and bankers of the City was held on the 4th inst., whereat a resolution was carried to the effect "that the limited area of the City of London, its immense and rapidly-expanding trade, should be protected against the intrusion of any railway not absolutely requisite for the public," &c., and an association was formed to enforce the views expressed at the meeting. The representation of the railway interest in Parliament is astounding, and when any question affecting this description of property is raised, there are

no fewer than 153 railway directors in the House of Commons, and 47 in the House of Lords, prepared with an unanimous "aye" or "no" immediately—an influence sufficient to ruin the nation. The plans now before Parliament, if carried out, would absorb an amount of capital equal to one-half the present investments, owing to the immense value of property through which the projected lines will pass. It is extraordinary that an institution, which scarcely existed thirty years ago, should have, in this brief space of time, acquired so inordinate a parliamentary representation.

How stands the telegraph service in this respect? There is a capital of about £10,000,000 sterling invested in this description of property, represented by seven directors in the House of Commons, a relatively satisfactory condition; but the number is totally inadequate to the prospective development of the system. It will be remembered by some of our readers that, towards the close of the year 1859, "the Lords of the Committee of Privy Council for Trade caused to be appointed a committee, consisting of gentlemen well known for their scientific attainments, and great practical knowledge, to enquire into 'the best form for the composition and outer covering of Submarine Telegraph Cables.'" As might be expected of thoroughly business-like men, they set to work, and the result of their labours is a report in the shape of some 500 folio pages, detailing their numerous experiments and enquiries, indeed a most elaborate treatise on submarine telegraphy. From the mass of information here collected, we had expected that the subject of telegraphy would be brought under the consideration of Parliament, and some steps taken to promote its adoption by the Government, and its extension as a means of communication with other parts of the world. But not a syllable has been uttered, not an action wrought since the report was published. Of late the House of Commons has devoted a considerable portion of time in investigating the claims of various designs and contrivances for the best method of constructing small-arms, rifled cannon, and iron-clad ships, and enormous have been the expenses incurred in the various experiments to determine the most destructive instruments of war; while telegraphy, which is destined to promote the arts of peace, is totally ignored. It is time that vigorous action was taken in this matter; but until some few eminently practical men are sent to Westminster—men who can demonstrate to the country the importance of the service they represent—so long will telegraphy be enshrouded in mystery, and all efforts to aid in its development as a preservative of the peace of Europe—in fact the world—be met with prejudice on the one hand, and indifference on the other.

We have already seen how rapid has been the development of the railway system, and to what its great success is to be attributed. Our strength has recently been augmented by the return of Mr. Moor (Chairman of the Mediterranean Extension Telegraph Company) for Brighton, and it is to be hoped that telegraphy will receive a fair amount of consideration in Parliament, and that the friends of this enterprise will be prepared with some thoroughly representative man at the next general election. We are already indebted to Lord Alfred Paget, Lord Alfred Churchill, Sir H. J. Leeke, K.C.B., &c., J. C. Ewart, Esq., Samuel Gurney, Esq., John Pender, Esq., and others, for their influence to extend the system of electric communication; but we shall not consider that telegraphy has made any great national progress until it is adopted by the Government as the regular medium of correspondence with our representatives in other parts of the world. Every accuracy and privacy is maintained in the instrument-rooms, and the wire might be used advantageously in all our political relations with other Powers; and we hope that very shortly the attention of the country will be directed to the immense reduction which might be effected in this branch of the national expenditure by the general adoption of the telegraph.

ON THE EFFECTS OF EXTERNAL PRESSURE ON INSULATION.

By LATIMER CLARK, Esq., M.I.C.E.

It being a matter of much interest to ascertain what might be the effect of the enormous external pressure to which deep-sea cables are necessarily subjected, many experiments were made on this point; the uniform result obtained was that the insulation was greatly and instantly increased, or, in other words, the conductivity of the insulator was diminished by pressure, and the improvement in insulation thereby induced appeared permanent so long as the pressure continued to be applied, but no longer. Wires of different materials were subjected to pressure for lengthened periods, but in no case could any evidence of permanent injury or change be obtained. India-rubber in a masticated state is known to be an absorbent of water, but the effect did not appear to proceed with greater rapidity under pressure than under ordinary circumstances. Very great difficulty was experienced in conducting these experiments satisfactorily, principally owing to the difficulty in making the joints. The impression derived from them was very decided, that there is no reason to apprehend any difficulty in deep-sea telegraphy as regards the insulation of the material generally, or of the joints.

The apparatus consisted of a small hydraulic press loaded with weights to maintain the requisite pressure, and of two parallel iron pipes, each 1-16th of a mile long, to contain the wire under experiment. The press was formed of an upright steel piston exactly one inch in diameter, working in a cylinder of wrought iron, and having a stroke of 18 inches. It was guided in its motion by a cast-iron frame. On the top of this piston was placed a saddle, from which depended four chains carrying a scale pan, in which were placed iron weights. The pipe leading to this apparatus was connected with two parallel hydraulic pipes of wrought iron, in which the wires under examination were placed. These pipes were each 110 yards, or 1-16th of a mile in length, and when not in use were open at both ends. They were laid side by side on a platform, which was about three feet higher at the distant end than at the press, to allow the ready escape of the air.

The wires under examination were drawn into these pipes, and the ends made secure by a stuffing-box of gun-metal. A length of No. 16 copper wire, covered with Wray's compound, of the diameter of ¼ inch and 220 yards in length, was drawn into the hydraulic apparatus, and the ends being secured, a pressure of 3 tons on the circular inch = 8,556 lbs., or 3 tons 16 cwt. on the square inch, was applied by means of the force-pump. This pressure is equivalent to a depth of 3,190 fathoms of sea water. A battery power of 512 cells was applied, and the insulation measured by the fall of the static tension, as shown on a "Milner's electrometer." The deflection of this instrument with a tension of 512 cells was 52¼°. The time was noted in which the needle fell from 52¼° to 49°, the temperature was 47°, and the time midnight. Before the pressure was applied the length of wire covered with Wray's compound took twelve minutes in falling from 52¼° to 49°. The pressure was then applied, and the insulation immediately measured again, and it now required twenty-five minutes for the tension to fall as before, from 52¼° to 49°; the insulation was twice as perfect as before. The pressure was then removed, and a third observation was made, when it was found to occupy eighteen minutes in falling to the same tension.

The following experiment was made on a piece of gutta-percha wire 110 yards in length, and of the same dimensions:—The pressure applied in this case was 3 tons on the square inch, or equivalent to 2,555 fathoms of sea water. The temperature was 54°, and the time midnight. The insulation was measured by the Milner's electrometer, and the time was noticed, during which the tension fell 10°; this was equivalent to a fall of the tension from 512 cells to 384 cells. Before the pressure was applied five observations were made, viz.:—

Time occupied in falling 10° on Milner's electrometer.

22 seconds.
23 "
23 "
23 "
23 "

A slight but unknown pressure was then applied, and the time of falling increased to 33 seconds; a little more weight was put on.

and the time increased to 60 seconds; with a further weight the time increased to 75 seconds; the weight was then taken off, and three observations were made, and each gave 25 seconds as the time for falling 10°. A portion of the weight was again added, and another observation gave 87 seconds. The whole pressure of 3 tons on the square inch was now added, and three observations taken, which gave—

Time of falling 10°.
110 seconds.
100 "
115 "

The pressure was kept on 15 minutes, and taken off for 7 minutes; five observations were then made, the results were as follows:—

Time of falling 10°.
22 seconds.
22 "
22 "
23 "
23 "

The pressure being again put on, three observations were taken of the time, which were as follows:—

Time of falling 10°.
120 seconds.
128 "
132 "

The pressure was continued 15 minutes, and was then removed for 10 minutes, when five more observations were taken, with the following results:—

Time of falling 10°.
24 seconds.
25 "
27 "
26 "
27 "

In another experiment made on the 31st of July, 220 yards of gutta-percha wire were submitted to pressure in the same manner as before. Before the pressure was put on three observations were made on the insulation; in each case the time occupied in falling 10° on Milner's electrometer was 15 seconds. A pressure of 3 tons on the square inch was then applied, and the insulation immediately taken again; in three successive observations the time of the tension falling 10° was 52 seconds. The pressure was then removed, and three more observations gave—

Time of falling 10°.
17 seconds.
17 "
16 "

In one of the above cases the insulation of the gutta-percha was increased five times, and in the other three times, and this effect was constant in all experiments, though not quite uniform in amount. The special material of the Gutta-Percha Company gave similar results. India-rubber improved also in the same manner, but it required care in measurement on account of surface moisture. These experiments, when conducted with the ends of the wire exposed to the air, could not be relied upon; it was necessary to lead them into a metal box with a glass cover, dried by chloride of calcium, and containing the electrometer, which was read through the glass, suitable air-tight sliding wires being provided for making and breaking the contact.

[We had the opportunity of witnessing the whole of the above interesting experiments.—ED. T. J.]

POROUS CELLS.

WE believe that the first application of porous cells for batteries in this country was that by Mr. Fothergill Cooke, in 1837. The cells were manufactured at the well-known works of Messrs. Davenport. Great improvements have recently been effected in the manufacture of such cells, which have rendered the battery more *constant* and continuous in its action. Mr. Culley, in his valuable work, makes the following interesting and practical observations on the subject:—"If the porous cell be of a bad quality, containing coke or metal dust, the copper will be deposited in patches upon it. When these patches of copper touch the zinc they form local circuits, like the particles of foreign matter contained in the zinc itself, wasting both sulphate of copper and zinc. When the porous cells become crusted with copper, they should at once be removed. The zincs should never be allowed to touch the porous cells, for copper will immediately be deposited on the porous cell, so as to form a local circuit with the zinc. The porous cells do not entirely prevent the mixing of the solutions; in fact, after a time, much of the copper solution escapes into the zinc cell. The zinc decomposes this copper salt, and copper in a metallic form, or as a powder or mud, is deposited on its surface, or falls to the bottom of the cells, while the acid, set free, dissolves the zinc. This deposit weakens the action of the battery, and in some cases, when the cells or pots are very porous, as much zinc is dissolved and sulphate of copper used when the battery is idle as when it is at work. The zinc cell should be much larger than that containing the copper, in order that the sulphate which leaks through may have more liquid into which to diffuse itself, and thus become more dilute, the zinc will then act upon it less rapidly. The liquid passes through the porous cell from the zinc to the copper, in virtue of a singular property, common to all porous substances when dividing dissimilar liquids, called 'osmose,' and it will frequently rise in the copper cell an inch or more above the level. The current aids this movement."

It will be seen from the above, that the quality of the porous cell exerts considerable influence on the efficiency and economy of the galvanic battery; hence the desirability of having the cells of the best possible material and manufacture. We have had to conduct experiments with batteries having no less than 512 porous cells, employed for eighteen months without having to replace but a very few from having become defective. Those cells are now extensively employed in the Muirhead improved batteries, both at home and abroad. Messrs. A. Singer & Co., of the Vauxhall Pottery, have forwarded us, for inspection, specimens of their improved circular porous cells, which are of superior manufacture, great care being taken in the preparation of the material, in excluding all impurities, and in the process of baking. In testing a cell for its porous quality, we found that it fully sustained the high character the manufacture has already received from several of our leading electricians. We do not, however, attach much importance to the glazing around the rim, as we have had an opportunity lately of examining several hundreds of cells, glazed and unglazed. The glazing appeared to us to make but little difference in the accumulation of the salts.

Silver & Co.'s improved porous cells are in use by the London Chatham and Dover, London Brighton and South Coast, and other railway and telegraph companies at home and abroad. This cell, from the nature of its construction, is one of the most constant and durable that has yet been introduced; its great superiority over the ordinary earthen porous cells hitherto used consists of the readiness with which the porous quality of the cells can be regulated to any desired quantity, the small consumption of sulphate of copper, and the duration of time they will continue working without any alteration. Cells of this description have been in continuous use in the telegraph department of the London, Chatham, and Dover Railway Company from October, 1862, up to the present time, with scarcely any perceptible deterioration excepting the zinc plates; it is, therefore, peculiarly adapted for any description of climate, both on account of its non-liability to breakage, durability, and consequent small cost for maintaining, which, after first cost, is comparatively nil.

THE SOUTH-EASTERN RAILWAY COMPANY'S TELEGRAPH.

THE Telegraph system, which has from an early date been in operation on the South-Eastern Railway is, as most of our readers are aware, the exclusive property of the Company. It consists of no less than 306 miles of telegraph, and the total length of wire exceeds 1,500 miles. The number of speaking instruments employed for public and railway purposes, at the present time, is 188. For the working of the trains there are in use 411 signal bells. Mr. Walker, in the discussion which followed the reading of Mr. W. H. Preece's valuable paper on Railway Telegraphs at the Institution of Civil Engineers, made the following remarks on the subject:—

As the extensive system of telegraph signalling in operation on the South-Eastern Railway had been only slightly mentioned in the paper, he deemed it incumbent upon him to make a few remarks, so that the members of the Institution, and the telegraph world generally, might be made better acquainted with it. In doing this, he should, unavoidably, have occasion to refer to it in plain terms, as his own system. It was his own, inasmuch as

he originated it, and it had been perfected under his care; he therefore felt a strong interest in it. It was not, however, the subject of a patent, so that he had no pecuniary interest in it.

From the remarks made by a previous speaker, it would have been gathered that "sound upon bells" was the basis of the system of train-signalling he was about to describe; without this, a leading feature would be gone. It would be right to place this matter historically correct before the Institution, in order that the origin of the bell-signal system, for which "Honourable Mention" had been awarded at the International Exhibition, 1862, might remain on record. In the autumn of the year 1851, a want was communicated to him by the then manager of the South-Eastern line. In his reply, of which the following was a copy, Mr. Walker described the system proposed to be introduced; and he had not since seen any reason to alter his opinion of its efficiency for train-signalling,

"South-Eastern Railway.

"Electric Telegraph, Tunbridge, Oct. 29th, 1851.

"My dear Sir,—In respect to the signalman at the Spa-road indicating the character of the up-trains to the switchman at the entrance of the South-Eastern and Brighton terminus at London, and to the latter having power to order either train to be stopped at the Spa-road:—The distance is 820 yards. It would require two* wires, which could easily be erected. I should construct two bells, of a totally different character to those used for the telegraph, and should use a different kind of battery.† One blow on the bell would indicate a Croydon train, two a Brighton, and three a South-Eastern. I would so construct the apparatus, that it could be relied upon. The expense would be very little, and it could not easily be deranged,

"Yours very truly,

"To Captain Barlow, (Signed) CHARLES V. WALKER,
"Superintendent." "Engineer and Superintendent of Telegraphs."

That letter described the foundation of the bell-system, as now in operation throughout the South-Eastern Railway. The first pair of bells were fixed and used January 22-31, 1852. The specification of Mr. Tyer's first patent was dated July 20th of the same year. At the present time, the South-Eastern line was protected in every possible manner by bells of the kind described—there were 330 bells in operation—some being connected merely in pairs, some with intermediate bells, and in other ways. Of these, eighty-four were provided with counting indexes, which indicated the number of blows sounded, and the remainder were plain. The total length of the South-Eastern line, thus protected, was 275 miles; and eleven other miles of the line were furnished with Mr. Tyer's instruments. Signal-bells were in course of erection‡ on the Caterham branch of nearly five miles in length. The Angerstein branch, of half a mile, which was without bells, was not used for passenger traffic. The Whitstable branch, of six miles, was provided with a pair of telegraph instruments, which were little used for speaking purposes, but served for signalling trains. From Ash to Shalford, upwards of eight miles, belonging to the South-Western Railway Company, but over which South-Eastern trains ran, electric signalling was not employed.

With respect to the cost of the telegraph signal-bell system, and the amount that had been expended by the South-Eastern Company upon it, in order to promote the safety of the traffic, he might state that the total cost on the 275 miles had been nearly £3,650, or at the rate of £13 5s. 3d. per mile, including wires, bells, and batteries complete. There was at the rate of one bell and a fifth for every mile, or one bell to every 1,466 yards; and the total cost on each 1,466 yards was £11 0s. 11d. The average cost per bell, including the "pecker" or ringing-key, taking the bells one with the other, plain and index, had been £4 6s. 6d.; and the cost complete, including batteries, had been £5 10s. 3d. The train signal-bells were in charge of the station-masters and the ordinary signalmen, so that the working expenses were not thereby increased to any appreciable extent. Loud-sounding bells, at least four or five inches wide across the mouth, were employed. The principle to which he had referred in his letter to Captain Barlow was, to wind the coils with No. 16 or No. 18 wire gauge, which was at that time an unusual size for an actual working telegraph instrument. The hammer which was attached to the keeper of the electro-magnet, was the only moveable part of the bell apparatus. The signals were given by the number of blows struck; the code for all ordinary purposes, called in practice "the general code," being one blow for an up train out, two blows for a down train out, and three blows for a train in. For blocking the line, the bell-signal was five blows; clearing the line after a block, three blows, or the in-signal given and taken twice. One fundamental and essential condition was, that every signal made by one man should be correctly repeated by the other man. If A made a signal to B, and the repetition was not given, it was an indication either of misunderstanding, or of something being wrong. No signal was allowed to be complete, until it was recognized by the return of the same number of blows that had been sent.

Independently of the above application, which was the simple and ordinary process of train-signalling from station to station, these bells were used in many ways and in a great variety of places; in fact, they were almost universally applicable. At the London platform, bells were the effective instruments for supplying a certain want. It now and then occurred that a South-Eastern tidal train and a Brighton train were due to start from the respective London platforms at about the same time. Should the South-Eastern tidal-train be unable to start to the minute, the inspector on duty had access to a "pecker," which enabled him to strike a certain number of blows, three, on a bell in the box of the signal-man who had the control of the entrance to both stations. This was an intimation that the South-Eastern train was not quite ready, and that the Brighton train might be allowed to go out. Again, at every level crossing, without exception, on the South-Eastern line, bells were placed in circuit in the gate-house, to be heard, but not to be answered. In this way indication was given that a train was approaching, either from A or from B, according to the number of blows; and the gate-keeper, hearing the sound of the bell, was made aware when the gates must be closed, till the approaching train had passed. In cases where the gate-house was close to a station, the bell was so connected that every signal sent to the station to which the gate belonged, from the station either to the right or to the left, was heard at the gate-house. Then, again, on the London Viaduct, there were two up lines to protect, and three different kinds of up trains to be distinguished. Between London and Redhill, one blow was given on the bells for a South-Eastern train, and two blows for a Brighton train. On the Bricklayers' Arms branch a still greater distinction had to be made. There were four kinds of up trains, and two kinds of down trains; and blows on the bells were arranged to meet these various circumstances. It was not desirable that bells should be required to express so many different things; but on that branch it was impossible to avoid it. The up distinctions were, South-Eastern engines, empties, and goods, and Brighton goods; the down, North Kent and main line. Again, at Hastings, Canterbury, and Paddock Wood, moving trains were indicated to the porters by a bell placed on the platform of the several stations. The men right and left of the stations did the signalling, a platform bell being placed on a continuation of the wire; so that all that was taking place at the signal-box, and required to be known by the station-master, was communicated by the bell. If a train was signalled as coming from St. Leonards or Winchelsea, the station-master at the Hastings platform knew what train to expect. At Ashford there were two junctions, which was another cause of complication, and several different signals had to be given by the bells. They were arranged in different groups, and spoke by the number of blows given. At Beckenham there was another extension of the same kind; and although the signal-man was somewhat removed from the station, the station-master heard by a platform bell the signalling that was going on in the signal-box, and had all the information he required of the various kinds of trains. At Margate the signals sent from Ramsgate were taken at the signalman's box, some distance from the platform, but these were heard also at the station. At Folkestone and Dover there were similar arrangements. Then there were small stations, which were closed at night, when the communication with the bells ceased. In such cases the signalling was done by the stations right and left, which were switched into connection before closing. Repairs were now going on in the Bletchingly Tunnel, during which a bell was placed in circuit in a hut at the tunnel mouth, within hearing of the men; and they were by its means made aware of the approach of a train.

One peculiarity about these instruments was, that they appeared to be the only kind of telegraph instrument that could be actually used, and that had been experimentally and successfully tried, with balanced currents. He communicated to the Royal Society, in 1857,* a short notice of the mode of working these bells with balanced currents. He subsequently found that a patent, of which he had not before heard, had been taken out by a Mr. Walker, of Glasgow; on looking to the specification, he could not, however, discover that any instrument had been conceived by which the system could be worked; nor could he ascertain that any use had been made of the patent. When the bells were arranged with balanced currents, the guard of a train, which might have become disabled between two stations, had merely to fasten a wire to the bell line-wire, and each time he touched the rail with the other end of the wire, the bells at the stations on each side were rung. No batteries or apparatus of any kind had to be carried with the train.

The system of signalling was so efficiently carried out on the South-Eastern line, that such a use of the bells as he had just described was hardly to be looked for. If a train did not arrive within a few minutes of its time, it was tolerably well known that it had broken down. However, if necessary, nothing more was required for putting all the bells in use into this balanced condition, than to take a couple of wires off their terminals, and to interchange them. Another advantage of the large wires with which these bells were wound, was, that although the gutta-percha covered wires buried in the London Viaduct were perishing,—those on which the bells were at this moment working giving what was technically known as "dead earth,"—still the bells worked very well through these moribund wires. One of the bells exhibited to the meeting was plain; and the other had the counting-index already mentioned attached to it. That was his idea of a really useful index. The bell-system had been so thoroughly carried

* The second wire was not found to be necessary, the viaduct-earth being sufficiently good.

† This was the graphite battery (since platinized), for which a prize medal was awarded at the Great Exhibition, 1851.

‡ Since these remarks were made, the Caterham branch has been fitted with bells.—C. V. W. Feb. 2, 1863.

* Vide "Proceedings of the Royal Society," vol. viii. p. 412.

out, that in some of the signal-boxes there were two, three, and in rare cases, as many as four bells. The bells differed in tone, and in the position they occupied. Should the noise of an engine blowing off steam, or any other cause, make it uncertain to a signalman how many blows had been struck upon the bells, or which bell sounded, he would find them registered by the index, which pointed to the number on a dial. It was a simple mechanism—a pair of pallets and a scape-wheel on the arbour, which carried the hand of the index to the precise number of blows struck upon the bell.

With regard to the semaphore to which Mr. Tyer had alluded, and which was for making the very signals proposed by Mr. Preece, it was constructed by him merely as an illustration about eight years ago, and was used at Tunbridge for some months. The pair of instruments now exhibited were alternate. They were shown at the Paris Exposition in 1855. The instrument was of very simple construction, consisting merely of a galvanometer needle, with a semaphore index as an outside needle; and did not differ in principle from Mr. Cooke's needle, originally used on the Norwich and Yarmouth line, and since employed on the London and North-Western Railway. Instead of an outer needle pointing right or left to written words, it carried an ivory arm on the top of a semaphore pole to be set up or let down, and required a persistent current to retain the arm in one of its positions, as Mr. Cooke's did for both positions; which should be avoided when practicable.

Of all instruments which had an index Mr. Tyer's was the simplest and most certain. The manner in which that index was arranged was very ingenious. It was a soft iron needle, hung loosely at the end of the core of the electro-magnetic coil; this was an original and good idea, and such a needle would be less liable to derangement than many others. These needles had worked admirably on the eleven miles of the South-Eastern Railway before referred to. It must be borne in mind that these indexes did nothing more than move to the right or to the left; more than this was required, and, as it had been seen, by the bell system much more was done. The bell system had been introduced by Mr. Bartholomew on the Brighton line; he had, however, made his bells much smaller, and had added an index with two positions. Mr. Radall had also adopted the pure bell system on the London, Chatham, and Dover Railway, employing smaller bells; but Mr. Walker thought it would be more convenient in all respects to adhere to the use of large bells.

The objection he had to an index was this:—His idea of train-signalling was, that a good understanding and communication should be established between two neighbouring stations. In explanation of his views, he had forwarded to the Institution of Civil Engineers, in the year 1856, a paper on Train-Signalling; but the subject not being then attractive, it was not read. On looking through this a few days ago, he found that there was scarcely a word in it which he would now strike out; and the paper could as profitably be read now as then. He would merely refer to it in illustration of the principles of train-signalling adopted on the South-Eastern line, and the instruments with which he had brought those principles into practice. The bells now in use were identical in their minute details with those therein described. He read from the paper four conditions, which appeared to him then, as they did at the present time, to be the basis of all train-signalling. There should, in the first place, be a good speaking understanding between the men at two neighbouring stations, A and B; and the four telegrams which were necessary between them were these—1st. "May I send a train?" given by station A striking one blow to B; 2nd. "Yes, you may," one blow struck back by B. Nothing could be simpler. The blow was a loud one, distinct in its sound, and readily understood. The third communication would be from B. 3rd. "The train you sent is in safe," intimated to A by three blows; to which the fourth message sent back from A—4th. "All right; I understand train is in." A repeating B's three blows. These four signals were booked by each station; the time at which each signal was completed being entered in the proper column, so that a double permanent record was secured. The admirable manner in which these messages were booked was shown in a late Government inquiry. Without unduly boasting, he might state that no collision had ever occurred on the portions of the South-Eastern line where these bells were in use, which was no bad illustration of how successfully they worked.

One chief reason why he continued to object to semaphores and indexes was, that the second of the above-named four signals was always contradictory, and did not mean what was intended to be conveyed. The first question was, "May I send a train?" The answer with the combined bell-and-index system would be, "Yes, you may not:" that was, whilst the bell reply said "Yes," the semaphore went up, or the index went over, which meant "No." It was true the "No" was understood to refer to any train that might follow the one in question, although it did not say so; but some day the index might say "No," and mean "No." In his mind, the signal was complete as soon as the men had exchanged signals, and had booked them.

To work the instruments, bells, &c., 6,900 battery cells are employed, of which 5,390 are platinized graphite. Mr. C. V. Walker, F.R.S., the chief superintendent and electrician of the company, finds that by platinizing the graphic plates the liberation of the hydrogen-gas from their surface is much facilitated, and that polarization, one great defect of single fluid batteries, is thereby diminished. The cost of the process is stated to be about one halfpenny per plate of the usual size of 7 inches by 3 inches. The platinized plates are also found to keep much cleaner than simple graphite plates.

The system of telegraph consists in all of 299 stations, and are thus classified:—1. Public stations, 94; railway stations, 205; = 299. 2. Speaking stations, 138; non-speaking, 161; = 299. 3. Bell stations, signalling, 152; do., hearing, 96; non-bell, 51; = 299. 4. Bell stations only, 161; bells and instruments, public, 56; do., railway, 31; instruments only, public, 38; do., railway, 13; = 299.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 115.)

6. *Special Arrangements (not Automatic) of Sending and Receiving Apparatus.*

Messrs. Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit a complete set of apparatus for the transmission, reception, and translation or retransmission of Morse signals through long submarine lines. No compensation or contrivance of any kind is provided for increasing the speed with which signals can be made to succeed one another without confusion; but provision is made for discharging the lines at the end of messages, and for preventing, under any circumstances, the discharge from passing through the home relay. The set for an intermediate station consists of—1st, two polarized relays of the construction already described; 2nd, two ink-writers similar in most respects to those already described, but so arranged as to be self-starting, and specially modified with a view to translation and to the discharge of the line into which signals have been transferred at the end of a message; 3rd, two Morse keys of peculiar construction; 4th, two lightning dischargers, two galvanometers, two commutators, and two distributors to alter the connections for direct reception or for translation.

The chief points of interest are to be found in the ink-writer and the key. The ink-writer is made self-starting by a very simple arrangement. The local current established by the relay passes round a second supplementary electro-magnet entirely distinct from that used to move the writing lever. The armature of the second electro-magnet is on one end of a rocking lever, the other end of which carries a little spring, resting against a drum, fixed on the axis of the last of a train of wheels, and acting as a break to stop the clockwork. The spring is lifted and the clockwork released, so soon as the local current is established, and the armature attracted. When the local current ceases, this break is prevented from immediately falling back on the drum by a little bent lever or boot, which slips down between the break lever and a second slowly revolving drum, at the instant the first lever is lifted. This little boot keeps the break-spring off the first rapidly revolving drum until slowly pushed on one side by the second drum, whereupon the break-spring falls again, and stops the clockwork. This, however, occupies several seconds, and if during all that time a single signal is received, the break lever is again lifted to its full extent, the boot slips back to its extreme position, and the stoppage of the clockwork is again deferred for several seconds. In this way, during the whole reception of a message, the little boot continually slips back, dancing on the second drum; and the clockwork, therefore, continues to revolve as long as signals continue to arrive, but will be stopped by the break-spring a few seconds after the reception of the last signal. It is difficult without a drawing clearly to describe the action of this very simple and perfectly effective little contrivance. The main writing lever is arranged so that it can be used to translate or retransmit the message received into a second section of the cable, and the break lever, as it may be called, fulfils two important functions in connection with the translation; it is permanently connected with the line into which signals are to be transferred, and is, of course, insulated from the framework of the machine. So long as it remains held up by the boot during the reception and translation of a message, it breaks a connection between the second line and its relay, so that the entering current does not pass through the relay; but no sooner does the break lever fall down than the connection between the line and relay is again completed, so that any answers sent by that line can at once be received by its relay, and translated back into the first line. Moreover, before connecting the end of the line with the relay, the lever and boot puts it for a short time in connection with earth, so that no discharge shall be sent through the relay to its detriment.

This is managed by a little piece of platinum on the centre of the boot; the boot is chiefly made of ivory, an insulator, and when either the break lever is quite held up by the boot, or when it is pushed quite out of the way, the metal drum below is only in contact with this ivory, so that the second line, although it is connected with the lever, is insulated at this point as well as elsewhere; but when the boot is halfway between these two points, a piece of platinum on its foot passes over a platinum ring on the metal drum, and makes contact between the lever and the metal drum, and so between the line and earth. Thus, a series of very complete combinations is effected by very simple means. The contacts required for translation are obtained, as already mentioned, from a lever in connection with the armature of the ink-writer.

The translator sends positive and negative currents with two contacts only, by means of a double battery. The traverse of this lever is considerable, and the time spent in this motion is entirely lost for the battery contacts. A great portion of this lost time is saved by a little spring on the lower side of the translation lever; the lower contact is made against this spring some time before the lever has reached its lowest position, and continues some time after it begins its rise. This spring can be so adjusted as to make the lost time very small, and the lower contact which sends the printing current can even be made longer than half the complete dot period. This counteracts the tendency of the dots to shorten at each successive translation.

The relays, as well as the ink-writers, are intended to work with reverse currents, which are sent from two distinct batteries by two simple contacts; one contact puts the line in connection with the positive battery, and the other with the negative battery. It is clear that a greater number of cells must be kept constantly in use for this plan than for that used by Sir Charles Bright, where positive and negative currents are indifferently sent from the same battery; but it does not follow that the consumption of zinc and sulphate of copper will be much greater, provided always the local action in the batteries be small, for each of the two battery circuits is only closed for half the time during which the single battery is closed, when one only is used. Messrs. Siemens state that, after considerable experience of both methods, they prefer the plan of sending reverse currents from two batteries, as simpler than the use of a reversing key.

The peculiarity of Messrs. Siemens' submarine key consists in a lateral motion given to the handle, by which, at the beginning of each message, the connection of the line with the home relay is first broken; secondly, the line is connected for an instant direct with the earth—a connection which, at this moment, is useless; and thirdly, the lower contact is connected with the negative battery. The upper contact is permanently in connection with a positive battery, and the lever with the line. If, therefore, the key be now used in the ordinary way, signals are sent by reverse currents. When the message is ended, the handle returns to its original position, and while returning, the lateral movement first removes the negative current from the lower contact, with which the lever, and consequently the line, is in connection when the handle is untouched; secondly, it puts the lever and line for a moment in connection with the earth, which discharges the line, and prevents any shock from passing through the relay, with which the lateral motion finally connects the line, leaving it in a position to receive signals from the distant station. The connections can be altered as required by conical plugs. The commutators, galvanometers, and lightning guard do not call for a special description.

The workmanship of the whole is excellent, and in the hands of skilled clerks, such as alone ought to be employed on submarine lines, will give very satisfactory results. It is, however, singular that this apparatus should contain no special provision for meeting the difficulties due to retardation from lateral induction in long submarine cables.

Messrs. Siemens, Halske, & Co. also exhibit Morse instruments, so arranged as to admit of the simultaneous transmission of messages along one wire in both directions; this apparent impossibility can be accomplished by very simple means, and Messrs. Siemens' arrangement is only one of several which have been proposed.

For convenience we will call the two stations A and B, and will suppose that ordinary Morse signals are to be sent with alternate battery and earth contacts, made by the usual Morse key, the lever of which is in connection with the line.

The relay has two coils which, with equal currents, will produce an equal effect on the armature; one of these coils is placed in circuit between the key lever and the line; the other coil is placed in a second circuit between the same lever and a set of resistance coils, the other end of which is in connection with earth. Each set of resistance coils is so adjusted as to be equal to the resistance of the line. The ends of the relay coils connected with the lever are so chosen, that two currents flowing from the lever through both coils shall have an antagonistic effect on the armature, and if the two currents are equal, the armature will be unmoved. The arrangements of the two stations are symmetrical. Now, let A signal to B; A depresses his lever, making contact between the line and the battery; the current flows from his battery into the lever, where it divides, one half flowing along the line after passing through one coil of A's relay, then through one coil of the relay at B, and to earth through B's lever; a perfectly insensible portion flows through the second coil of B's relay, the armature of which moves under the influence of the single coil, and B receives the signal in the usual way. The other half of the current flows through the other coil of A's relay, then through the resistance coils, and so to earth. This second half of the current is exactly equal to the first, since the resistance of the two circuits is equal, and the two equal but antagonistic currents leave the armature of A's relay unmoved; now, while A's lever is depressed sending a current, let B also depress his lever to send a signal to A. The current from B's battery splits in the home relay through the two coils, the one half neutralizes the current which is received from A, but the other equal half, passing round the second coil of the relay *from* the key, produces exactly the same effect on the relay as the received current would when passing through the first coil *towards* the key. Thus the armature of the relay continues deflected, or begins to be deflected, exactly as if it simply received A's signal through the first coil.

It has been observed that the current sent by B into the line neutralizes the current sent from A, and the consequence in B's relay has been shown; but this neutralization is also felt in A's relay, where no current now passes round the first coil. On the other hand, one half of the current from A's battery passes round A's second coil, and being unbalanced by any current in the first, works A's relay, and this current flowing outward from the key through the second coil, produces exactly the same effect as a current flowing inwards from the line to the key through the first coil. Thus we see that, whether the lever at A's station is up or down, in contact with earth or the battery, its relay works whenever the second station sends a signal. It is worked directly by the received current, in the usual way if the lever is up, and indirectly by its own battery if the handle is down. But the lever may be in a third position—*i.e.*, between the two contacts; in this case the received current passes in through the first coil to the lever, and then out through the second coil to the resistance coils, and so to earth. The two coils in this case produce effects which must be added, instead of subtracted; but, on the other hand, the resistance of the whole circuit is doubled, and the current consequently halved. The armature of the relay will, therefore, experience exactly the same attraction in this third case as in the two others. If, therefore, the resistance of the resistance coils of each station be kept exactly equal to that of the line, signals will be received in exactly the same manner, whether the key lever be up, down, or in an intermediate position; in other words, whether it is making a battery or an earth contact, or neither.

This ingenious contrivance has not been found practically useful. The resistance of lines varies considerably as the weather varies, and the clerks either cannot or do not care to make the corresponding changes required in the resistance coils. The resistance of the batteries should also be insensible compared with that of the line, and the electro-motive force of the two batteries should be equal; conditions probably somewhat difficult to fulfil in practice.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2,864), exhibit an electro-acoustic telegraph, used at all stations where much business is transacted by them. The system was introduced by Messrs. Bright. Both Professor Wheatstone and Dr. Steinheil, of Munich, combined an acoustic system with their early telegraphs, but the present is the only apparatus of this class practically used in Europe. The sending apparatus, as already mentioned, consists of a pair of finger keys capable of rapid manipulation, and so connected that the operator sending does not pass his own currents through his acoustic apparatus, which on the key rising is ready to receive signals from the other end. One key passes the positive and the other the negative current. The receiving apparatus consists of a relay and two bells of different tone, one on the right and the other on the left hand of the operator.

The relay has been already described; it completes a local circuit through the electro-magnets of one of the two electric bells, one of which corresponds to a positive, the other to a negative current. This system has obvious advantages as compared with the needle telegraph. The eye of the receiver is set free, and he can write the message as it is received as though from dictation; with this incidental advantage, that each word is heard, not as it is pronounced, but as it is spelt. It is found that from this cause messages are more correctly written down than when two men are employed, as with the needle telegraph, one to read the signals as he sees them, and the other to write from dictation: thus, one man not only does the work of two, but does it better.

Advantages are also claimed for this system over the ordinary Morse recording instruments; it is said to work more rapidly—that is to say, to transmit a greater number of words per minute. Forty words per minute have been accurately received, but in practice the clerks are ordered not to work at a greater speed than twenty words per minute. It is urged that there is at least as much chance of error in writing out the message from marks seen on paper, as from the sounds heard by the ear. It is also said that, from the employment of trains of wheels, the Morse recording telegraph does not admit of that facility of conversation, and rapidity of correction, peculiar to the needle and acoustic telegraph. Moreover, the acoustic telegraph is of itself an alarum. The only objection which can apparently be urged against it is the absence of all mechanical record of the messages received.

Telegraph companies can alone decide on the practical value of this objection. Sir W. O'Shaughnessy in 1861 reported that the substitution of an acoustic system for the Morse tape system effected a saving of about £3,000 per annum on the Indian lines, and was accompanied with twofold greater accuracy. The British and Irish Magnetic Telegraph Company are of opinion that the acoustic system saves them several thousands a-year in writers.

The States Railway Society, Vienna, M. (Austria, 666), exhibit an ingenious arrangement, by which batteries for transmission are required only at terminal stations, and, except for local purposes, are altogether dispensed with at intermediate stations.

Two equal and opposite batteries are constantly in connection with the line at the terminal stations; by depressing the key at either end, the clerk at that station removes his own battery from the line, and replaces it by a direct earth connection, which allows the far battery to work the distant terminal receiving instrument, and also the receiving instruments of all the intermediate stations. The keys of the intermediate stations, when depressed, remove their own receiving instrument from the circuit, and put an earth connection to both sides of the line through two sets of resistance coils of such length, that the currents produced by the two batteries, which work all the other receiving instruments, are of very nearly the same strength as that produced from the one battery when a terminal key is depressed. This system has been in practical use for about two years, and is now applied on about four hundred miles of line, with sixty-three railway-stations, and seventeen Government stations; its application is to be still further extended. There are some obvious objections to the plan, but these are met by the facts that it has worked successfully, saving 60 per cent. in the cost of batteries, and that it is being rapidly extended to fresh lines. Those who require fuller details will find an excellent description of the instruments and connections in the "Notice on the objects sent to the London International Exhibition," published by the Austrian State Railway Company.

Digney Brothers, M. (France, 1,414), exhibit what may be called a portable station for military or other similar purposes. A box, 15 inches by 7 inches by 7¾ inches, contains a key, a direct working Morse ink receiver with paper rollers, &c., complete, a galvanoscope, and all the necessary connections. The battery is carried in another box; or one of Messrs. Siemens' magneto-keys, already described, may be used instead of a battery.

J. Leopolder, Vienna, H. M. (Austria, 657), exhibits a still more compact arrangement, in which every requisite for Morse-signalling except the battery, is contained in a box 12½ inches by 8½ inches by 3½ inches.

(To be continued.)

Bonelli's Telegraph Company.—We were sorry to learn that the aerial cable, erected across the Mersey by the Bonelli Telegraph Company, had been again damaged by the mast of a vessel, necessitating a suspension of the company's operations for several hours. The cable has, however, been repaired, and is now in working order.

STEERING SHIPS BY TELEGRAPH.

At the Royal United Service Institution, on the 4th inst., a highly interesting lecture was delivered by Lieutenant A. H. Gilmore, R.N., upon the application of electric telegraphy to the steering and general management of a man-of-war. The lecturer stated that it was now seven years since his late brother directed attention to the subject, and proposed an apparatus for the purpose to the Admiralty, which had then been tried with perfect success on board some vessels of small size. The same system has recently been accepted by the Admiralty, and is now in use, with certain improvements, on board the Resistance, the Hector, Prince Consort, Orlando, Orontes, and the Queen's yacht, the Victoria and Albert, having been first adopted in that ship on the occasion of her voyage to bring the Princess of Wales to England. The great value of a system of perfect communication throughout any ship must be evident, as it is from the want of this that so many accidents happen. Ships come into fatal collision in fogs and dark nights before it is possible to alter the course by word of command. The man at the look-out has first to give his signal, and this is taken up by the next man, and so the word is carried, often in a gale of wind, through several men to the steersman, who possibly gets an imperfect, or even a directly contrary order, while, if he gets the right one, it is often too late. Many hairbreadth escapes in this way are commonly to be heard related by seamen, and no doubt small craft are sometimes run down which might have been avoided had it been possible for the man at the helm to act with sufficient promptitude. The apparatus appears to be extremely simple, and it is only surprising, now that we are shown it, that it was not adopted long ago. There is in front of the wheel at which the helmsman is stationed, a neat stand, somewhat like a sun-dial stand, with an upright dial-plate, upon which works a hand or indicator, and this plate is made transparent at night by a lamp. When the ship is steering "steady," the hand is vertical, or at rest, by its own gravity chiefly, and points to the word "steady;" when the course is signalled to "port," or "starboard," the hand moves to the left or right hand, as required by the officer in command, who of course directs the key-handle upon a similar dial-plate before him. But by an ingenious contrivance a sharp-sounding gong is struck with every signal, so that the man's attention is called to the dial-plate before him. If he is ordered to steer so many spokes of the wheel to port or starboard, the officer gives three, or any other number of strokes upon his dial, and the gong sounds at the same time. If the order "hard down" or "hard up" helm is to be given, it is only necessary to repeat the strokes rapidly. Mr. Gilmore showed the apparatus in action, and it worked in the most exact and unmistakeable manner. For ships of war, and especially the cupola ships, it would seem to be quite an indispensable means of working them efficiently, as orders may be sent about the ship with accuracy under any circumstances, and with a rapidity quite impossible in the noise either of a storm or a battle. Mr. Gilmore purposes to have a kind of table with several dial-plates upon it, each of which is in communication with a certain part of the ship, as the fighting quarters, the engine-room, the cupolas, and so on; this would be placed in the captain's pilot-house on deck, and thus the necessary orders to fight the ship by manœuvring in any way, to the magazines and to the broadside guns, prepare to fire, to change or revolve cupolas for the other tack, and in case of attacking as a ram, to charge or to back off as needed. The immense advantages of all this need not be dwelt upon; but the lecturer pointed out especially that in modern warfare by steam it would be of great importance to be able to manœuvre the ship rapidly, and to fire instantaneously at a ship moving with high speed. The double screw propellers which are now coming into use would not, he thought, be fully available without this method of conveying orders instantaneously. As to the ease with which sailors would learn the meaning of the signals and the working of the system, Lieutenant Gilmore felt quite sure that there was less difficulty in this method of steering than in the old one of steering by the compass.

The Magnetic Telegraph Company have lately extended their wires from the railway-station to the Catholic-hall, Blackburn, and on the 9th instant the new office in the Catholic-hall was opened for public business. This office, from its central situation, will be a great boon, not only to the merchants and manufacturers, but also to the inhabitants generally of Blackburn, who are thus placed in immediate communication with nearly every town in the United Kingdom.

SUBMARINE TELEGRAPH COMPANY (LIMITED).

The ordinary half-yearly general meeting of the shareholders of this company was held at the London Tavern, on Friday, the 4th inst., Sir James Carmichael, Bart., in the chair.

The Secretary, having read the notice calling the meeting, the chairman proceeded to affix the seal of the company to the register of the shareholders. The report having been agreed to be taken as read,

The Chairman said that in moving the adoption of the report, he was happy to be able to announce a steady and satisfactory increase in the revenue of the company since their last half-yearly meeting, and that, as compared with the corresponding period of last year, they were earning more than £100 per week over their receipts at that period, and this in the face of the fact that two of their cables were inoperative, the Emden cable being under repair, and the Danish, being in the hands of the Austro-Germanic authorities, not being allowed to be worked; the directors had, however, received information from their agent at Berlin, that an arrangement would in all probability shortly be made by which they would be allowed to work the line for commercial purposes, without detriment to their interests with either of the governments. The charges for repairs during the past half-year had been unusually heavy, owing to the very tempestuous weather, and for the past six months a steamer had been constantly employed with repairs, so that it was considered that the directors now knew the worst that could happen, the cost of the repairs appearing in the accounts as £5,244, which included four miles of 6-wire cable, spliced on to the Ostend line. The Calais cable had also been repaired, after only an interruption of two days, whilst some of the repairs could not be accomplished under several months. He had to congratulate them that now they had a *bona fide* reserve fund of £4,000, in North-Eastern Railway Debentures, and that, if the meeting agreed to the accounts presented, it would shortly be increased to about £6,500. He had a melancholy topic to introduce to them, namely, the death of their most valued coadjutor, Mr. John Watkins Brett, and who, in fact, appropriately has been called by Professor Morse the father of submarine telegraphy, and who had been of eminent service to the company, for whenever an emergency arose, he was always ready to give his time and money to get through it. With regard to the extension of telegraphy, he might remark that in 1845 Mr. Brett made a proposal to the Belgian government to connect Belgium with this country by a submarine cable, but the proposal was laughed at. Since then, however, submarine telegraphy had proceeded so rapidly, that he hoped next year would witness the union of America with this country, by means of the Atlantic cable, which would just be twenty years since Mr. Brett's first proposal was made with regard to Belgium. He must now refer to another loss the company had sustained by the resignation of their late secretary, Mr. Courtenay, whose courteous behaviour to every member of the company had gained him the esteem of all, whilst it was with much pleasure that he bore testimony to the zeal and ability with which he discharged his duties. Mr. Courtenay had accepted an appointment in connection with the Indian government, but the directors had been fortunate in securing the services of Mr. Clare, the accountant to the company, who would discharge the duties of both offices. At a meeting of the shareholders, in 1859, a vote was taken, by which the remuneration of the directors was raised to £1,000 per annum, but it was afterwards found that, on account of the meeting not being made special, and no notice being given, the vote was illegal. The amount was then reduced to the original allowance of £400, but, as they were desirous of strengthening their Board, by the addition of two gentlemen of high standing in society, they would require something to offer them for their services, they should, therefore, at the proper time, have to ask them to increase the annual allowance to the directors. He had now only to move that the report, with the statement of accounts, be received and adopted.

Mr. Hindmarsh seconded the motion.

Rev. W. Horton wished to know whether any damages had been recovered on account of the injury done to the Dover and Calais cable by the Swedish vessel.

The Solicitor, in reply, said that the point had been brought before the Law Courts, and it was contended that the company had no right to lay their cables at the bottom of the sea, and that they could not recover for any damage done to them; it was, however, now legally decided by the judges that they had a right to lay their cables, and that they could recover for wilful damage done. The next point which must yet be decided by a jury, was whether the cable was maliciously injured; that, however, remains open for the present.

The Chairman said that the damage done would amount to about £1,000, that the owners of the vessel were large and highly respectable gentlemen in Sweden, and connected with a house of business in London; consequently, should the case come before a jury and a verdict obtained, there would be no fear about obtaining payment; but the trial had taken place more for the purpose of establishing their right to lay their cables at the bottom of the sea, and that was now decided.

Rev. W. Horton said that his chief reason for asking the question was to bring out the decision which had been arrived at. He thought it very important that it should be known that the question had been authoritatively settled, that those persons who injured the cables were amenable to the owners thereof for the damage done. There was a little discrepancy in the accounts, which, he had no doubt, might be readily explained, but which did not appear just then clear to him. In the joint balance sheet he found the amount of reserve fund, on June 30th, 1863, stated to be £3,922 18s. 10d., whereas, by reference to the balance-sheet, on the 31st December, 1862, he found £1,219 15s., and on the 30th June, 1863, £2,214 8s. 3d., making it altogether £3,434 3s. 3d., and not £3,922 18s. as stated in the accounts. He should like to have that matter explained.

The Secretary stated that at the moment he could not give the explanation, but if the proprietor would call at the office, he would show him the books, and make it quite clear.*

Mr. Braithwaite remarked that an important question with a submarine company was the maintenance of the cables in a state of efficiency, he should, therefore, like to know whether they saw their way clear to reckon upon any specific amount as the cost of repairs during the year; these amounts appeared to vary constantly, and until they could arrive at something like an average for repairs, they could not tell how to reckon upon the cost of working.

The Chairman considered it impossible to make a calculation. They had had as severe a trial during the past year as he thought they could well have, and should reckon that £8,000 a year would keep their cables in proper order. He had never found any firm or company willing to contract for the repairs of the cables, and he did not think that any would undertake it. All the repairs which had been done had been paid out of the revenue.

The motion for the adoption of the report having been put to the meeting, was carried unanimously.

The Chairman then moved, "that in accordance with the recommendation of the court of directors, a dividend for the half-year ending 31st December, 1863, at the rate of 4 per cent. per annum (less income-tax) upon the capital of the company be declared, and that it become payable on and after the 12th day of March next," which having been seconded by Mr. Maxwell, was carried unanimously.

The Chairman next moved, "that the Right Hon. James Stuart Wortley be one of the directors of the company."

Mr. Braithwaite, in seconding the motion, remarked that it was very obvious that every year increased the importance of electric telegraphic communication, and such had been the increase during the past year that it showed the necessity of their having gentlemen on the board of directors whose position in society would enable them to command that consideration for the company which its importance demanded. Mr. Wortley was chairman of the Atlantic Telegraph Company, and held a high position in the country, and he was glad to find his name proposed to be added to their board, for it was most desirable that they should have as large an amount of influence as possible, seeing that it was probable that the globe would eventually be encircled with wire.

Mr. Reid said that he considered that the board was large enough already. There were six on the board, besides the chairman, and he thought that sufficient. He thought that it would be better if the consideration of that question was deferred until the dividend was larger. He should like to know the amount of holding which both Mr. Wortley and Mr. Moor had in the company? (The Chairman: £1,000 each.) He should prefer good business men to members of Parliament, for he considered that they had enough to do in other ways. He merely threw this out as a suggestion, and not for the purpose of causing division.

The motion having been put from the chair, was carried unanimously.

The Chairman next proposed, "that Mr. Moor, M.P., be one of the directors of the company," which having been seconded by Mr. Scamell, was also carried unanimously.

Mr. Braithwaite said that he had now to propose, "that the yearly allowance to the directors be £1,000." He thought that the time was now come when they should increase the amount to be allowed to the board for managing the affairs of their company. They had now turned the corner in their financial affairs, and he thought that they ought to accede to this proposition. It was only those who were acquainted with the working of the company that knew the laborious duties of the directors, and he therefore hoped that no objection would be made to the motion he had now proposed.

Mr. Chatfield seconded the motion.

In reply to a question,

The Chairman said that £360 per annum was allowed for the management of the French company, of which there were three directors; so that the total allowance for the expenses of direction, if the motion was agreed to, would be £1,360.

The Rev. W. Horton felt pleased that the accounts of the company were such as to justify them in increasing the remuneration of their directors, and he thought that, by agreeing to this proposition, they should be expressing what they were bound to express, namely, their sense of obligation to the directors for the way in which they had conducted the affairs of their company, and their confidence in the fidelity of their management in the future.

The motion was carried unanimously.

The thanks of the meeting having been voted to the chairman and the board of directors, the meeting separated.

* The Secretary explains this by stating that £488 15s 7d., the amount of reserve fund belonging to the French company, on 30th June, 1863, is included in the amount of £3,922 18s. 10d., which sum is shown to the credit of the reserve fund in the annual BALANCE-SHEET presented on this occasion.

TELEGRAPH CLERKS' PROVIDENT FUND.

THE first half-yearly meeting of this society took place on Tuesday evening, at the offices of the London District Telegraph Company, 90, Cannon-street, E.C.; G. Sheward, Esq., presided. The room was crowded with members of the society.

Letters having been read from the Honourable A. Kinnaird, and others, expressing their regret at not being able to attend, the Secretary announced that Mr. Alderman Salomon, M.P., had liberally sent in a donation of £5 5s. towards the fund.

The SECRETARY read the report, from which it appeared that the progress of the fund was most encouraging and satisfactory, the committee having been enabled to invest £184 2s. in the purchase of Three per Cent. Consols to the value of £200. The annual subscriptions amounted to £55 12s. 6d., although the fund had only been in operation since October last, and it now numbered seventy-one members, composed entirely of the clerks and employés of the different telegraph companies. The claims, up to the present time, were limited to two, which were both on the sick fund. Dr. Cousins, 49, Camden-road-villas, has consented to become honorary physician to the fund. Dr. Peplow, 111, Great Russell-street, Bloomsbury, has been elected medical officer of the fund. Dr. Sutro, of Finsbury-square, had consented to act as consulting physician, and, through his introduction, Messrs. Baumgarten, of 113, Leadenhall-street, had undertaken to prepare his prescriptions for any member of the fund at cost price.

The CHAIRMAN, in moving the adoption of the report, explained the advantages attendant on joining the society, and entered at some length into explanations of a string of questions which had been addressed to him by one of the members.

The motion for the adoption of the report and the balance-sheet having been seconded, was carried unanimously.

The officers were then re-elected, and a vote of thanks accorded to the chairman for presiding on the occasion.

Mr. SHEWARD, in returning thanks, congratulated those present on the fact of the Princess of Wales having become a patroness of a society composed of so many of her own sex, and said the thanks of the meeting were due to her Royal Highness for the very liberal donation which she had forwarded.

The proceedings then terminated.

CORRESPONDENCE.

ATLANTIC TELEGRAPH CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—Will you, or any of your correspondents, kindly answer the following queries in the next number of your valuable journal:—

1st. In what stage of construction is the Atlantic Telegraph Cable; when is it likely to be finished? 2. About what time is it likely to be laid, and its probable landing place? 3. What instruments are likely to be used in working that cable; whether the Morse code?

A CURIOUS SUBSCRIBER.

[The manufacture of the Atlantic cable has not yet been commenced, but we are informed that there is every prospect of its being completed, and ready for submergence, in May, 1865. At present it is understood that the termini will be Valencia, in Ireland, and New Perlican, Trinity Bay, St. John's, Newfoundland—a point which has been found to possess many advantages over the late station at Bull Arm. The instruments to be used for transmission have not been decided upon, but we believe that every effort will be made to ensure the employment of those instruments which are found to be best suited to this description of work.—ED. T. J.]

THE RELAY.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—Mr. Fleeming Jenkin, in his report on the various instruments at the International Exhibition of 1862, gives a very interesting account of the different forms of *Relays* which are in use in various countries. The following quotation describes the first relay patented by Messrs. Cooke & Wheatstone, in 1836-7:—"In the improvement for sounding alarums in distant places by the aid of an additional voltaic battery, which is brought into action when required for sounding the alarum, the sounding thereof being either by direct application of the attractive force of occasional magnetism, or by applying such force to let off clockwork alarums, the requisite occasional magnetism is excited by an electric current derived from that additional battery, the metallic circuit by which that current is so derived from the said battery being formed (when the same is required to act) by an angular motion then communicated to a magnetic needle, which is disposed within multiplying coils of conducting wire, through which an electric current is transmitted from a distance, the angular motion of the needle being caused to make the requisite contacts for forming the metallic circuit of the additional or alarum battery."—Yours, &c., TULE.

CURIOSITIES IN SUBMARINE TELEGRAPHY.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—In August and September last year, it was announced that the amount of capital the Atlantic Telegraph Company required had been subscribed, and that—at the *unanimous* recommendation of a scientific committee, consisting of Captain Galton, R.E., Mr. Fairbairn, Professors Wheatstone and Thomson, and Mr. Whitworth—the tender of Messrs. Glass, Elliot & Co. had been accepted; and also that *the* cable was then and there being manufactured, the contractors being bound by their contrac to make and submerge the same, and hand it over to the company, in complete working order, in the summer of 1864.

We are now in March, 1864, and what do we find? That although the contractors and their friends may have become liable for 20 per cent. of the capital, that there is nevertheless such a deficiency as to checkmate all procedure—so that there is not now an inch of the cable being or yet made. The type of cable thus scientifically selected—the same as the Algiers cable—is a curious and paradoxical fact, when we refer to the report of Captain Galton and Mr. Fairbairn, when acting on the Government Commission, whilst, also, the two Professors, as Jurors to the Exhibition of 1862, make the following statement as to that particular form of cable:—"This form of cable would deserve a much fuller description than is here given, were it not for the fact, that it probably will not again be used." "The toredo consumes the hemp with great rapidity, leaving a mere bundle of loose wires round the core, which cannot then be lifted for repairs."

Besides these curiosities, it is well to bear in mind that this selection of cable is come at after years of dear-bought experience, and abundance of facts, which go to show that out of upwards of 15,000 miles of cable submerged, first and last, there are not now, at this moment of time, 2,000 miles of telegraphic lines of communication in effective working order, or any in deep water—whilst a moiety of these are multiple wire cables, differing in their mechanical construction from the peculiarly-successful single-wire conformation selected by the scientific committee for the depths of the Atlantic.

Experience teaches! Can anyone wonder that the public feel shy to join in ventures, however great and grand, when so administered? And how do the results tally with the chairman's statements at the public meeting held in Liverpool last spring?

March 8, 1864. MAGNA EST VERITAS ET PREVALABIT.

[Our correspondent is erroneously impressed as to the present position of the company.—ED. T. J.]

TELEGRAPHING WITHOUT WIRES.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—Would you be kind enough to inform me, through the columns of your journal, whether a patent was not taken out a year or two ago for telegraphing between different places, without wires—and if so, if the same has been practically applied?

If not troubling you too much, perhaps you could further inform me as to the nature of the apparatus and the electricity employed.

I am, sir, yours,

Southport, March 8, 1864. A READER.

[Mr. Haworth has patented a system of telegraphing without wires. We insert an extract from Mr. Haworth's specification, filed on the 26th Sept., 1862. We were not present at the experiments.—"The size and power of the battery will depend, in some degree, upon circumstances—such as the distance to which it is intended to convey the message, the strength and direction of the earth's currents, and even the state of the weather, more power being required in dry than in damp weather. These points must be taken into consideration, and allowance made for them. For a distance of ten miles from Notting-hill, Bayswater, Middlesex, to Croydon, in Surrey, I have found a Smee's battery of two cells at each end, containing plates three by five inches, to suffice. For about 50 miles, from Notting-hill, Bayswater, to Brighton, in Sussex, I have used, with success, a Smee's battery of three cells at Notting-hill, and the same number at Brighton. For 200 miles from Notting-hill, to Bangor, in Wales, I have required six cells, with plates of the size above named. I have found that less power is generally required to convey a message from north to south and from south to north, than from east to west, or from west to east." Haworth's last patent was taken out a few weeks ago, and so soon as the specification is published, it will be inserted in this journal. Mr. Haworth is, we believe, abroad at the present time.—ED. T. J.]

TELEGRAPHIC FEATS.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—In your impression of March 5th an "Old Double Needle and Morse Clerk" says, "A Morse-sending clerk can be instantly arrested." If not trespassing too much on your space, I should feel obliged if he would say how this is effected?

I am, sir, yours, &c.,

March 8th, 1864. D. W.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Although I think no real benefit can result from the controversy as to the respective merits of different systems of telegraphy, I think the letters appearing in your issue of this day call for a reply. Anyone connected with telegraphy is well aware of the fact that, as a general rule, telegraphists are prejudiced in favour of the instrument they are accustomed to work; and in reading their opinions, allowance must be made for this.

"Fairplay" and "Bon Accord" seem to be relating the same feat as to the transmission of the Queen's Speech, and I cannot reconcile the difference of their statements, one giving the rate of speed as twenty-seven and the other as thirty words per minute.

From several years' experience of telegraphy in the Magnetic Company, and an acquaintance with the Morse and electric instruments, I cannot believe that, with the instruments employed by the Electric Company, a speed of thirty words per minute could be maintained, although it might be obtained for one or two minutes.

Of course a great speed can be attained for a few minutes—as an instance of which, *one hundred and three words* were transmitted to Manchester, and written down there by a clerk from bells in two minutes.

Your correspondent "W.H.N." states fifteen words per minute as the rate of the single needle (electric) instrument; and in stating this, I do not think your correspondent referred to the Morse, but to the old single needle instrument of the Electric Company, the speed of which is about the rate mentioned by your correspondent. He further says, referring to the Morse instrument, "A yarn must be finished before the sender can be stopped."

This is contradicted by your Dover correspondent, who is doubtless in the service of the Submarine Company, and is unaware of the fact that on some (if not all) of the electric Morse instruments, the receiving station cannot stop the sender until he has finished sending.

Your Dover correspondent alleges that bad writing (I presume on Morse slip) may be deciphered if carefully scrutinised, whilst on bells it must be repeated. I cannot see any advantage in time would be gained by the "scrutiniser" over the "repeater."

Another Dover correspondent alleged that the Morse instrument is superior to the bell instrument for the transmission of messages in foreign languages. Such a statement could only be made by one who is either strongly prejudiced in favour of the Morse system, or who is unacquainted with the working of any other system.

Any advantage obtained by the Morse instrument would be merely from the fact, that in general the clerks attending foreign circuits are acquainted with foreign languages—an advantage the clerk attending home circuits does not usually possess; but even with this advantage, I doubt the superiority of the Morse instrument, for I can instance *one hundred* messages for the continent being received from bells by a London clerk from Liverpool in one hour and fifty-five minutes, the majority of which were in foreign languages, and the whole of them were counted and timed by the receiver. I do not think this could be *equalled* by any Morse clerk.

No one unacquainted with the bell instruments can possibly appreciate their great value and utility.

With regard to the assertion, that the magnetic instrument is unsuited for long circuits, I do not think a much longer circuit is worked by the Morse instrument than one completed by the magnetic, viz., London to Queenstown and Valentia, *viâ* Cambridge, Doncaster, Liverpool, Stranraer, Belfast, Dublin, &c. Trusting you will find room for this in your valuable journal,—I remain, sir, yours obediently,

J. H. HARPER.

London, March 5, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The discussion which has been going on in your columns for the last few weeks, as to the relative merits of the several signalling instruments, has been deeply interesting to me, as it has, I have no doubt, been to all telegraph clerks. Notwithstanding all that has been said *pro* and *con*, I hardly think a single convert will have been made by either side, for all expert clerks (the best judges) have what I may call an affection for the instrument with which they are most efficient. I wish to speak impartially, and can fully recognise the great benefits which the Morse instrument possesses in that it records whatever is sent, which for reference must necessarily be of great value; but does this virtue counterbalance the difference in speed which exists between the Morse and bell instruments? Taking the authority of your Dover correspondent (in February 20th) thirty words per minute seems to be a good performance for the former, whereas the bell instrument is capable of doing forty-five of the same matter—*i.e.* the bell instrument would transmit three columns of a speech while the Morse was doing two. This is a great difference in speed, and I do not think the recording faculty of the Morse compensates for it. Morse clerks will be loth to allow that their instrument is surpassed in speed by the bell instrument, but I beg to remind them that all the signals transmitted by the keys of the magnetic instrument are dots, and must of necessity occupy less time than when copiously interspersed with bars, as in the case of the Morse, both keys having a downward motion. It seems to be inferred by many of your correspondents that the bell instrument is not a correct one; probably they arrive at this conclusion from their own acquaintance with unrecording instruments; but I can assert from experience that in this respect there is no comparison between a needle and a bell instrument, the ear being a much surer mode of communication than the eye. If this discussion has no other effect, it will have given prominence to the capabilities of an instrument which, until now, has not received a due appreciation of its merits.—Yours obediently,

Bradford, Yorkshire, March 8th, 1864. MAGNETO.

THE TELEGRAPH CLERKS' PROVIDENT FUND.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In reply to Mr. Newbury's letter, in your last week's journal, I must observe that the denouncement of his meeting was too severe against the newly-established Telegraph Provident Fund, of which that excellent and benevolent lady, Miss Oppenheim, is the secretary.

I do not come forward here to dispute what has been said, but merely to observe, that although in most cases the assertions were true, the deductions from them were harsh, as the following statement may show.

In round calculation the sum of 3d. per week is demanded (not a very exorbitant amount), for which trifling payment we receive, in cases of illness, a weekly allowance of 10s., and in that of temporary disorder the best medical advice from a physician, together with assistance from the Fund. No doubt this society, as with most others in their commencement, must ere long undergo some modification; but looking at the fact—and one which my own experience can prove—that telegraphic employés are invariably of a sickly temperament, it ought not to be grudged that some benefits should fall to the other side; and notwithstanding the society's late formation its sick list is already large, and much greater than was at first anticipated.

It is always easier to condemn than praise, and still more so to do evil than render good; but, sir, when we consider such management as the board is composed of, when such names stand forward as Mr. Samuel Gurney, Sir Morton Peto, and others of gentler form as the patronesses, whose very names echo virtue and munificence, only give time to the undertaking, and little will be the fear of the result.—Yours, &c.,

GEORGE BENSON.

Submarine Telegraph Company, 58, Threadneedle-street, E.C., March 9, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I am glad that Mr. Newbury has so fully explained the reasons why he and his friends are not satisfied with the rules and regulations of the above Fund, as it affords a fair opportunity of discussing the matter in your columns, the result of which I trust will be to remove the unfavourable impressions from your correspondent's mind and others for whose benefit the Fund has been established. I believe that the production of certificates of birth or baptism, &c. are indispensable before being admitted as members into any of our well managed and regulated provident institutions. No insurance on life can be effected in any office without such certificates, as well as those of the medical officers appointed to examine as to the applicant's state of health, &c. I think that such requirements and precautions should not be considered as likely to exclude the clerks and others employed under telegraph companies from becoming members.

Rule 2, which renders it incumbent on the part of the patients to "find their own bottles, &c.," and to attend at the houses of their respective surgeons before ten o'clock in the morning, might be with advantage modified or, indeed, expunged altogether.

When the members of the Fund are so widely dispersed over the country it is essential that certificates for claiming sick pay should be signed by either the minister of the parish or some other responsible person in the town in which the applicant resides; the absence of such a precaution might lead to irregularities.

Rule 9th certainly should be modified. It is absurd to attempt to debar the male members from enjoying the healthy and invigorating recreations, such as cricket, the racket, or the exercise of the gymnasium, or to prohibit the female members from joining in the merry dance, &c.

With the above exceptions I do not think that the rules are in any way oppressive, by requiring of the members to go through humiliating formulas, &c., and I hope that Mr. Newbury and his friends will lend their co-operation to carry out the object of the institution, bearing in mind that in union there is strength, and that by the exercise of a little forbearance towards those who have had to toil and labour against much discouragement and apathy, and who are anxious to extend to telegraph employés the advantages of a Provident Institution on a permanent and secure foundation, the wishes of himself and others will meet the consideration to which they are justly entitled.

In conclusion, I do trust that the institution will be the means of removing what I still must characterise the senseless prejudice and rivalry which have too long existed between those employed under our various companies.—Yours, &c.,

March 8, 1864 A SHAREHOLDER.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—I am glad Mr. Newbury has furnished us with the reasons of his disapproval of the Provident Fund. Judging from the long list, a careless observer would naturally infer that the society has been hastily bungled together, without a thought as to the welfare of the parties to be benefited; but a moment's consideration will convince the reader that the majority of the Magnetic objections are puerile in the extreme. We must, however, give our friends of Threadneedle-street their due meed of praise for the gallantry with which they take up cudgels on behalf of the fair sex, and do battle for the weaker vessels. Mr. Newbury and his confrères grow virtuously indignant when they learn that female members will not derive sick pay and medical attendance when visited by the illness accompanying maternity. I have not expressed myself with that grace, ease, and pathos which the self-imposed champion of our oppressed and suffering sisterhood revelled in when he condemned the shortcomings of the fund in this respect. At present I believe there is no member of the society in immediate want of this relief, and when the necessity begins to be felt means, I have no doubt, will be found to meet it, in the formation of a special subscription for these "happy events." It would be a manifest injustice to the male subscribers to allow this relief to come from the general fund. Mr. Newbury assumes that the rule referring to accidents, &c., attending sports and games, is injudicious. I can easily explain this, by mentioning that by some clerical error the word "unlawful" has been omitted before sports. But the grand point of objection is the "technicalities!" How unfortunate it would be to wound the tender susceptibilities of a would-be young mamma by quoting her correct age, and how unpleasant to reveal the melancholy fact that your father is older than he was twenty years ago. Baptismal certificates are not insisted upon unless some reasonable doubt is entertained of a candidate's statement of age. I think our friends of the Magnetic would show themselves to greater advantage if they had come forward to lend a helping-hand to those who are endeavouring to benefit them, instead of holding themselves aloof, and unfairly criticising what has been done for the mutual benefit. I quite agree with "A Shareholder" upon the rivalry existing between the various services. In the case of the Fund, it is to be lamented that it did not take rise in Threadneedle-street, or owe its origin to Lothbury. Some such idea as this inspired Mr. Newbury when he referred to its "soi-disant" connection with the District Telegraph Company. Neither of the services possess any official influence over the society. The District Company has, indeed, come forward with great liberality, which contrasts very favourably with the spirit manifested by larger and wealthier telegraph communities. I am led to hope that, after a while, the fund will be independent of these extraneous means of support, and will depend entirely upon itself. This will not be the case for some time to come. In the meanwhile I would earnestly appeal to my fellow-employés to advance, by every means in their power, the moral, social, and general prosperity of the telegraph clerk.

ONE OF THE LEAST.

London, March 9, 1864.

[We had a letter from "One of the Least" in type last week, but owing to press of matter it was excluded; at the request of our correspondent, it has been cancelled, and the foregoing published in lieu thereof.—ED. T. J.]

TELEGRAPHIC NEWS.

THE ATLANTIC TELEGRAPH COMPANY.—A vacancy has occurred in the direction of this company by the demise of Sir Wm. Brown, Bart., of Liverpool.

THE GREAT EASTERN STEAMSHIP.—In anticipation of the contract for manufacturing and submerging the Atlantic cable, the eminent firm of Messrs. Glass, Elliot, & Co. have secured the Great Eastern for the latter purpose. This vessel has many advantages over ordinary ships, as from her great length there is an entire absence of pitching, and as the magnitude of her hold will admit of the whole of the cable being paid out into the ocean at one length.

GISBORNE'S MECHANICAL SHIP STEERING APPARATUS.—In one of our early numbers we gave a description of a very ingenious apparatus, the invention of Mr. F. N. Gisborne, for steering vessels by the aid of electricity. We have had an opportunity of examining an exceedingly efficient apparatus, contrived by Mr. Gisborne for the same purpose, by mechanical means, which we intend fully to describe in a future number. The apparatus is to be seen at Mr. Gisborne's office, Adelaide-place, London-bridge.

THE ATLANTIC TELEGRAPH.—In 1862, Captain Orlebar, of the U.S. navy was employed to make a survey of Trinity Bay, Newfoundland, for the purpose of ascertaining whether there was not a more suitable landing place for the Atlantic cable than Bull Arm. From his report we learn that at New Perlican there exists a deep channel, which will form an excellent bed for a telegraph cable; that the adoption of this place for a terminus would enable the Company to effect a saving of 40 miles of cable, besides placing the line in immediate communication with New York and the interior of the American continent. Captain Hoskin, R.N., has also been engaged in a survey of the Irish coast, and his report confirms the previous selection of Valentia, in the south of Ireland, as the most eligible station for the Atlantic telegraph. It is pretty generally understood that these recommendations will be acted upon, and that the cable will be submerged in the summer of 1865.

ELECTRICITY AND WARFARE.—Experiments are being made, in the evening, at the Danish head-quarters, with electric light, with a view to apply it to warlike purposes, to watch the enemy's movements in the night, and to enable the artillery of the forts to fire in the darkest weather. With what practical results such contrivances are attended we shall soon learn.

QUEENSLAND'S TELEGRAPH.—Amongst the public works in the above colony, the chief and most important is the construction of the first railway, and after that, but hardly inferior in interest, is the proposition for the extension of telegraphic communication to the northern parts, with the view of making the wire available ultimately as a link of the proposed Anglo-Indo and Australian line. For this purpose a sum of £85,500 has been granted by the legislature.

THE PERSIAN GULF TELEGRAPH.—By advices from Bombay to the 14th ult., we learn that the first section of the Persian Gulf telegraph cable, 359 miles in length, from Gwadur in Beloochistan to Cape Mussendom on the Arabian coast, has been successfully laid from the ships Kirkham and Marian Moore. Colonel Stewart and Sir Charles Bright arrived off Cape Mussendom at noon on the 9th instant, and their telegram through the cable announcing the completion of the work thus far reached Bombay at three p.m. the same day. Dr. Esselbach, superintendent of the Mekran telegraph, who accompanied Colonel Stewart, committed suicide by throwing himself overboard at sea in a fit of nervous excitement. From the *Bombay Gazette* we learn that the Tweed, which is the third of the cable ships, has arrived, and is only waiting for the Ferose, now overdue, to be towed up the Gulf, when the laying of the second section, from Cape Mussendom to Bushire, will be at once commenced. The Assaye, with the third section on board, left England nearly four months ago, and anchored in our port yesterday; and the probabilities are, that by the end of March the whole length of the cable will have been submerged, and that Bombay will be in direct telegraphic communication with Bussora. Recent letters from Bagdad, however, make us anxious for the safety of the short land line from Bussora to that city, the Arabs having already, as we learn, broken the wires and ill-treated the workmen engaged in the construction of the line. Another difficulty likely to make itself felt when the cable has been laid down is the inefficiency of the present telegraph from Kurrachee to Bombay. It will be most vexatious if, after so many more serious obstacles have been successfully overcome, telegraphic communication with England is interrupted precisely where it ought to be most safe and regular. The Arabs between Bagdad and Bussora may be quieted partly by threats and partly by bribery, but the Indian telegraph department can neither be frightened nor coaxed into doing its work properly, and the sole remedy is for an independent English company to make a line of its own between Bombay and Kurrachee. A portion of the above information appeared in a second edition of this journal last week.

PARLIAMENTARY NEWS.

GOVERNMENT TELEGRAMS.

Mr. D. GRIFFITH asked whether a despatch from Earl Russell to Lord Bloomfield, at Vienna, of the 18th of January, 1864, to which an answer was returned by Lord Bloomfield, of the date of the 19th of January, from Vienna, printed among the Danish papers, was sent by telegraph from this country: and whether the Secretary of State for Foreign Affairs would have any objection to direct that in future dispatches sent by telegraph should be distinguished from those sent by the ordinary means of communication, in order that the dates of dispatches might correspond with the facts of their transmission and answers, and be at once intelligible to members of the house without further explanation.

Mr. LAYARD regretted he was unable to explain himself clearly to the hon. member the other evening. He would, however, again endeavour to do so. Those dispatches which were published were not sent by telegraph, but they were founded upon short telegrams sent in cypher. Each telegram was afterwards extended into a full dispatch, in order that the house might have the whole matter before them. For the very obvious reasons that telegraphic messages must be very short, they could not be produced literally in their original cipher. Care was, however, taken, when acknowledging a dispatch, to state whether it was telegraphic or not. The hon. gentleman would find from the answer whether the original dispatch was sent by telegraph or not. If, for example, it was considered necessary to send a dispatch from London to St. Petersburgh, with the view of receiving an answer on the same day or the day afterwards, it was evident that it should be sent by telegraph.

Mr. D. GRIFFITH complained with warmth that the hon. gentleman had not answered his question. He had given him notice of his question, which he wished to be answered by his chief, and he presumed that the hon. gentleman would have come there to answer it on behalf of his chief (hear, and laughter).

Mr. LAYARD said he really did not know what answer he could give to the hon. gentleman. It seemed to be quite impossible for him (Mr. Layard) to make the hon. gentleman understand. In the very dispatch to which the hon. gentleman alluded, the answer stated that it was a telegraphic dispatch. It would be an insult to the sense of the house to explain that a dispatch sent to St. Petersburgh, which was replied to on the same day or the day afterwards, must have been sent by telegraph (hear, hear).

MISCELLANEA.

MR. HORACE JONES, who has recently been elected City Architect, in the place of the late Mr. Bunning, designed the Magnetic and Submarine Company's Central Station, at 58, Threadneedle-street.

LATELY a Belgian author proposed that the guillotine should be replaced by the electric discharge. "Fancy the criminal," says he "standing on the scaffold addressing the multitude. The hand of justice lowers itself upon his head, the electric spark flashes and cuts him short. . . . Death, which we fear so much, is only *the pain multiplied by the time,* and electricity, travelling some two hundred and forty thousand miles per second, whilst the biggest criminal rarely exceed two yards, the passage from life to death would be accomplished in about the one million four hundred thousandth part of a second!"

GLASGOW CONTROLLED BY ELECTRICITY.—We have to call the attention of the public to the clock controlled by a current of electricity, from the observatory of the Glasgow University, which is to be seen in one of the windows of the establishment of Mr. Nunhead, clockmaker, Buchanan-street. This interesting and beautiful specimen of the application of scientific result, to the useful purposes of life, is furnished with a conspicuous dial, about three feet in diameter, upon which revolve hour, minute, and second hands, enabling the passer-by to ascertain Greenwich mean time, at any hour of the day, with the utmost possible precision. The pendulum terminates on a coil of wire, and as it swings to one side and the other the coil alternately envelopes and discloses two permanent bar magnets, which may be seen underneath. As the pendulum of the standard clock at the observatory vibrates to and fro, it presses slightly against a spring, which causes the current of electricity to flow from the battery at the observatory along the connecting wire coil of the pendulum, which becomes from this cause an electro-magnet for a short time during each successive second, and the mutual action existing between this temporary magnet and the permanent magnets which it embraces, and the course of its oscillations constitutes a controlling influence by which the pendulum of the distant clock is made to vibrate in perfect unison with the pendulum of the standard clock at the observatory. We hope ere long to see several of these useful apparatus established, for the public benefit, in different parts of the city.—*Glasgow Daily Herald.* [The good citizens of Glasgow seem to have forgotten that a similar clock was erected in the town many years ago by their ingenious countryman, Mr. Alexander Bain.—ED. T. J.]

THE ROYAL INSURANCE COMPANY.—On Thursday, the 11th of February, George Edward Taunton (on behalf of some of the shareholders) obtained an injunction to restrain the directors of the Royal Insurance Company "from paying or making good any loss or damage occasioned by the burning of the vessel *Lotty Sleigh,* or the explosion or concussion thereby produced, upon or in respect of any policy or insurance granted by them against loss or damage by fire, and from allowing or paying, or causing to be allowed or paid out of the funds of the said company any claims arising from such loss or damage aforesaid." The case came on for hearing on the 29th February, and appeared to create a deal of public interest, and as the decision of Vice-Chancellor Sir Page Wood is important, not only to the directors of large companies, but to the public generally, we quote the following remarks from the summing-up:—"This is a case of considerable importance in reference to the management of all societies of a joint-stock character. The court has been always careful to prevent the application of the moneys of the shareholders who contribute to these enterprises—to prevent the funds being applied to any purpose other than that which is legitimately the purpose and object of the association. On the other hand, it is not for the benefit of the shareholders that the legitimate business of the association should be in any way impeded by narrowing the powers of the board of directors, in such a manner as to prevent the board from carrying the objects of these great associations into full and complete activity, according to the best modes that may present themselves to the minds of the directors, and which are within the ordinary course of business. It is not a case of applying the funds to purposes ultra the purposes and objects of the association, but the purpose to which the directors have applied the funds is, undoubtedly, whether rightly or wrongly, for the purpose of securing to the company the best profits that they think can be secured by their mode of conducting the business."

THE discoveries of Franklin displayed the influence of electricity in the production of the most magnificent phenomena of nature. That of Volta has led to the development of its connection with her more silent but important processes. Like the power of gravitation, it seems to apply more extensively the farther its investigation is pursued. Like that power, too, its nature may for ever escape our cognizance; but the contemplation of its effects may supply new facts calculated to extend the resources of art, and enlighten our conception of the infinite variety and harmony of natural phenomena. Such pursuits are amongst the best sources of intellectual improvement, for they call into action the highest powers of the mind, and present a constant succession of interesting objects for their exercise.

ON the occasion of the opening of the telegraph line between Cape Town and Graham's Town, the press of the latter telegraphed the following distich to that of the former:—

"Good Lord, what fools ye be,
To send such message up to *we.*

N.B.—The right of translation is reserved by the authors."

TELEGRAPHIC FAC-SIMILES.—A correspondent has furnished us with an account of experiments made in April, 1848, which we insert:—A trial was made, between London and Brighton, of Mr. Bakewell's copying telegraph, to test whether distance would interfere with its powers of transmitting copies of writings. An instrument at the central office of the Electric Telegraph, in London, was placed in connexion with a corresponding instrument at the York Hotel, Brighton, and a communication in writing was opened between those stations. Several messages, the *fac-similes* of the writing applied to the instrument in Brighton, were received in Lothbury, in the presence of gentlemen connected with the telegraph company. The writing formed by electro-chemical decomposition could be distinctly read, and the signatures could be recognised. The rapidity with which the transmission was effected was about 150 letters per minute, and a much greater speed is said to be attained when the instruments are in regular work. The messages were written in full, with capitals and points, but abbreviations and even short-hand symbols, might, it is stated, be used. In addition to the authentication of communications by the signatures of correspondents, and the avoidance of errors by the transmission of *fac-similes* of the original messages, this telegraph is regarded as possessing peculiar means of maintaining secresy. Some of the communications from Brighton to London on Thursday were impressed invisibly on the paper, so that no trace of writing could be seen until the messages were washed over with a chemical solution, when they became visible.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities.....	2/3 to 2/6 per lb.
Good re-boiled..............................	1/7 to 1/10 „

INDIA RUBBER.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/6 „

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	104 to 107	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$\frac{1}{2}$ dis. to par	—
10	Mediterranean Extension Tel. .	all	$3\frac{1}{2}$ to $4\frac{1}{2}$	—
5	London District Telegraph Co..	all	$1\frac{1}{2}$ to 2	—

TO CORRESPONDENTS.

D. N.—The line to which you refer is the Whitehaven and Isle of Man telegraph.

W. H. N.—Your communication arrived too late for insertion this week, but will receive due consideration in our next issue.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street, E.C.; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column).........	0	3	0

THE TELEGRAPHIC JOURNAL.

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THE REPORTS OF TELEGRAPH COMPANIES.

IT is always gratifying to the Directors of Joint Stock Companies to meet their Shareholders—when there is a dividend to declare; or, at least, satisfactory progress to report. Proprietors are ever anxious to learn the actual condition of their investments, and look forward with considerable interest to the periodical renderings of their responsible men. Few of the persons who invest capital in telegraph property are aware of the extraordinary disadvantages under which their Directors labour, or of the onerous duties devolving upon their officers. Not only are difficulties experienced in raising capital at the outset, but obstacles are met with at every stage in the progress of the work, and even when the line is completed, competition frequently threatens to impair the value of the property. In submarine projects the most able Directory are often frustrated in their efforts to provide for the contingencies to which their cables are subject—the dragging of ship's anchors, damage by lightning, the discovery of faults in the most remote parts of the line—these, and a host of other disasters, have to be provided against, and yet the Directors are enabled to make these lines pay good dividends. It needs but little of the prophetic faculty to enable those who are acquainted with the nature of these investments to foretell that, so soon as several impediments to the complete success of subaqueous telegraphy are removed, that the value of this description of property will be increased tenfold.

Some idea of the internal economy of Telegraph Companies may be derived from a perusal of the reports published from time to time. The Directors of the Universal Private Telegraph Company, which was established to promote the more general use of Professor Wheatstone's beautiful instruments, held their annual meeting on the 23rd ult., and submitted their accounts, made up to the 30th August, 1862, at which date they exhibited a favourable result, except as regarded the capital account, which was clearly insufficient to develope the works commenced. The Directors found it necessary to obtain certain modifications in their agreements with Professor Wheatstone, which he cordially acceded to. These arrangements having been completed, the Directors proceeded to distribute among their friends the balance of the share capital which was subscribed for in Glasgow and Manchester; but as it was deemed advisable to encourage an interest in other towns, especially as it was understood that Newcastle and Liverpool desired to take a pecuniary interest in the Company, 827 shares were reserved for that purpose. After encountering considerable obstacles the Directors secured the consents requisite to the introduction of the Company's wires into Liverpool, and the works are progressing very satisfactorily in that town. At Manchester, Newcastle, Glasgow, and Belfast, the system has been developed in a very satisfactory manner, with every prospects of remunerative business. The entire accounts presented, made up to the 31st September last, showed a total expenditure of £61,764 0*s.* 5*d.* on the revenue account. The balance standing to the credit of the Company in August having been brought forward, the net revenue amounted to £3812 7*s.* 7*d.*, out of which a dividend of 5 per cent. was declared (which will absorb £1784 6*s.* 2*d.*), leaving a reserve of £2028 1*s.* 5*d.* Thus it will be seen that the telegraphic business of the United Kingdom is gradually extending itself, and becoming more generally appreciated than was anticipated a few years ago; and, notwithstanding the competition which now exists in all large towns, we must congratulate the Universal Private Telegraph Company upon being able to declare so satisfactory a dividend.

The half-yearly meeting of the Submarine Telegraph Company was held on the 4th instant, and the report presented was certainly very encouraging, though replete with stories of vicissitudes by land and sea. From this interesting document we learn that two of the cables had become inoperative: the Emden cable under repair, and the Danish line is being in the hands of the Austro-Germanic authorities. isnot allowed to be worked. The charges for repairs during the past six months have been unusually heavy, amounting to £5244. This large item in the accounts was attributable to the very tempestuous weather experienced, necessitating the constant employment of a steamer on the coast to make good the damage occasioned by the late gales. Since the last meeting of the Shareholders, a considerable reduction has been made by the different administrations in Germany in their internal traffic, which was expected to increase business to a very great extent; the Company has also been engaged in a very important lawsuit, still pending, for damage done to the Dover and Calais cable by the dragging of the anchor of a Swedish vessel, called the Gustaff Adolphe. When first the Company took their case into court it was decided that they had no right to lay their cables at the bottom of the sea, and that they could not recover for any damage done to them. It has now been legally settled by the judges that they had a right to lay their cables in the sea, and that they can recover for wilful damage done to them—a most important decision to all persons engaged in telegraphy, and one which will compel mariners in future to exercise greater care in casting their anchors on the route of a telegraph cable. A point, however, still remains for a jury to decide in this case, *i.e.*, whether the Dover and Calais cable was maliciously injured. The damage occasioned will cost £1000 to repair, but there is little doubt, if the Company obtain a verdict, about their receiving compensation from the defendants, as they are highly respectable gentlemen in Sweden, connected with a house of business in London. Notwithstanding these drawbacks the Directors were enabled to recommend a dividend of 4 per cent. per annum, although the capital had been largely increased by the issue of New Stock; to add the sum of £2518 8*s.* 2*d.*, being 10 per cent. on the receipts to the revenue fund; and to carry over £774 13*s.* 9½*d.* to the next account. Mr. Courtenay (the late esteemed Secretary, who recently accepted an appointment from Government in connection with the Indo-European Telegraph), has been succeeded by Mr. Clare, who now fulfils the duties of Secretary and Accountant to the Company. The directory has been very materially strengthened by the appointment of the Right Hon. James Stuart Wortley, Chairman of the Atlantic Telegraph Company, and Henry Moor, Esq., M.P., Chairman of the Mediterranean Extension Telegraph Company, and we hope that submarine telegraphy will enjoy a greater immunity from disaster, as our knowledge of the conditions to be complied with in this description of work increases. The experience already gained—at a great cost certainly—will enable future projects to be carried out with a greater probability of success; and we wait with no small

degree of anxiety the union of this country with America by a line across the bed of the Atlantic. Meanwhile we must express our satisfaction with the present aspect of the telegraphic enterprise, and indulge in anticipations of the time when the whole world will be placed on speaking terms by the wire.

OUR PROSPECTS.

VERILY the Electric Telegraph is the wonder of the world! Nothing during the last few years has created so marvellous a change as the electric revolution of science. Beneath it the features of old Christendom have become changed, and its wealth and grandeur augmented. Other revolutions have scattered luminous influences over the world, peopling it with the precious things of the present and the past; but it remained for the introduction of telegraphs to bring about one of the mightiest moral and social revolutions that ever hallowed the annals of any age. The marvellous electrical agency by which the commerce of the country is being promoted and matured, as yet only in its embryo or initial state, forms one of the wondrous characteristics of the age—an age which is emphatically utilitarian and mechanical; an age of steam and electricity, of the axe and the hammer, of the windlass and the wheel—Electro-telegraphy unquestionably forms the greatest discovery in what has been termed the century of science, and every one well knows that it owes its birth, its growth, its glorious and unparalleled march, to that industrious pursuit of honourable but gainful adventure which is the very basis of England's greatness. It is the swiftest of all messengers. Omnipresence is one of the principles of its progress. Not content with making England its lineage-home, it aims to form a girdle round the globe itself, and rears measureless dominions throughout its circuits. From the steppes of the Cossacks it already flashes along its insulated path to the shores of the Atlantic ocean, and the lands of "ruined hills and broken altars" are being converted into shrines sacred to commerce, by a magnificent power which traverses the profound depths of oceans, spans territories, enfranchises commerce, and consolidates confederacies, makes the adamantine divisible, and gives to man lordship over time and space. We hail with unfeigned satisfaction the prospects of the speedy realization of an Atlantic telegraph, of which our columns of this week bear ample evidence. The fortunes of telegraphy should be no longer involved in the doubtfulness of experiment—the system is no longer a theory. And we trust that now, on the eve of the ultimate attainment of great and magnificent results, that those who so long have stood steadfast to the "good cause," will not be turned aside from the path of victory when in sight of the goal and the fruit of their labours and anxieties handed over to others who never took any part in earning it.

It has frequently been our duty to illustrate, by the state of trade and commerce existing at the moment, and by reference to the simultaneous condition of telegraphic revenue and profits, the sympathy, almost amounting to mutual dependence, which may be discovered in the relations of all the great departments of business by which the position of England at the head of the world in arts, arms, civilisation, and humanity, must continue to be maintained until the far-distant period of our declension in the scale of nations. It is not so much the tacit and indolent recognition of great economical and social truths, as the impression they make on the acting minds of men, that gives importance to the continued and emphatic enunciation of them. Much as the attention of ingenious and clever men has been directed to the scientific questions connected with the progress of electricity, the *statistics* of telegraphy—those branches of their operation which exhibit their harmony with the springs of the nation's strength and happiness—remain in the obscurity of comparative neglect. They have not been brought so closely *en rapport* with men's immediate contemplations of self-interest as older subjects, of infinitely smaller importance, but which have the advantage of familiarity, and of that "association of ideas" that exercises so great an influence over the fancy rather than over sober judgment. It may even yet take a long time before the world is prepared to understand how large a part a mere novelty is playing, and how much a larger one it yet has to play in the influences and transactions on which the vitality of the empire depends, and on which depends the subsistence of the thousands of new subjects who are yearly born to the leal service of our excellent Queen. But these practical truths cannot very long hide themselves; they must become known by their effects, even if we foolishly shut our eyes to them until they are forced on our notice by the dearest of all lessons—those taught by experience. As in cases of this kind a world of subsequent tribulation and loss may be avoided by a community recognising in time the indications of great though new events, and preparing itself to take advantage of them, rather than engaging in an effort to stop the eternal progress of mind and nature, we think we shall be doing good service to society by continuing to remove misimpressions, and to raise up correct and adequate ideas upon a subject in which we feel all the public to be profoundly interested.

INDICATING AND DISPERSING FIRE-DAMP IN MINES, &c.

THE immense loss of life which has from time to time taken place from the generation and accumulation of fire-damp, &c., in coal-mines, has naturally led many scientific men and others to endeavour to devise means of averting the recurrence of such catastrophes. The Geordie and Davy lamps have rendered valuable services to the miners, have been the means of saving the lives of hundreds, and have rendered a large amount of property productive that the proprietors were unable to turn to any profitable account; still the danger arising from working in coal-mines, where inflammable and explosive gases are generated, is a source of constant apprehension on the part of the miners and the proprietors. Our attention has recently been called to a very simple and ingenious contrivance for indicating the presence of fire-damp or choke-damp in mines, for dispersing the same, and also for telegraphing in mines, by Mr. E. N. Gisborne. The fire-damp, or hydrogen gas, which is generated in a coal-mine, is of less weight or specific gravity than the atmospheric air; and the choke-damp, or carbonic acid gas, in a mine is of greater weight or specific gravity than the atmospheric air; and the invention of Mr. Gisborne consists in the employment, in combination with suitable apparatus, of these relatively lesser or greater weights to connect an electric circuit, and thereby cause the required indication or signals to be given. The following are some of the modes in which weight or pressure are employed for the purpose:—In a glass vessel or chamber, which is open at one end, is suspended a delicately poised lever, and the mouth of the vessel is closed and rendered air-tight by means of a double layer of very thin india-rubber, strained over a ring, so as to leave a clear space of about half an inch between the layers; a small stud of metal is then inserted in the inner layer, immediately over the upper end of the lever, and a wire from the battery is also passed through the side of the vessel into the space between the two layers, so that its point may nearly touch the metal stud, and a wire is also passed through the side of the vessel below the inner surface of the inner layer, and its point brought nearly to the end of the lever, so that when the atmospheric air in the vessel is expanded by the agency of lighter gases, the inner layer is pressed upward, and the metal stud is brought into contact with the wire between the layers, and the circuit is thereby completed; and on the other hand, when the upper surface of the layers are deflected by the agency of heavier gases thereon, the upper end of the lever is depressed, and the lower end being thereby brought into contact with the wire in the vessel, the circuit is completed. The like results are obtained by the means of the pressure of the gases on

a vacuum chamber similar to that in an aneroid barometer. The like pressure contact is also employed to connect an electric circuit through a Ruhmkorff coil and condenser, and by causing the current to pass thence between two metal points placed *in vacuo* in the interior of a glass bulb or chamber, to illuminate such bulb or chamber; and the like pressure contact is employed to connect an electric current from a battery at the surface, and by a galvanometer or electro-magnet withdraw an opaque slide from the front or back of a coloured bull's-eye in a Davy lamp, and expose the coloured light. The drawal and withdrawal of the slide in a Davy lamp by the means mentioned is employed, and also the illumination of the bulb or chamber, for the purpose of telegraphing or communicating signals from one part of a mine to another, or from the interior thereof to the surface or pit's mouth by arbitrary signs; thus, for example, a continuous red light may be used to signify "danger from fire-damp;" two movements may mean, "send down the cage," and so on; and in like manner, one, two, or more flashes or illuminations *in vacuo* may be used to signify pre-arranged sentences. The pressure contact is also employed to give signals by releasing or moving an electro-magnet, to sound an alarum, ignite an explosure compound at the surface, or otherwise indicate danger. The fire-damp may be dispersed by forcing it as it is generated by means of the pressure contact, completing the circuit, and igniting some explosive compound.

THE AUTOMATIC TELEGRAPH OF MR. THOMAS ALLAN, C.E.

BOTH in this country and in France great changes in our existing telegraphic systems are under discussion, and it is certainly high time that some great reform—or, to say the least, some great advance—were made in the matter. The time has now arrived when it must be made known that telegrams in this country cost much more than they ought, not chiefly on account of the large profits made by the existing companies, but rather because the improvements which have been made in telegraphic apparatuses have put into our hands the means of doing what those companies with costly contrivances, cannot afford to do. Unfortunately for them (and for the country also) it is impossible to engraft many of the most important modern improvements upon the apparatus now in use. What we require is to commence a new and improved telegraphic system *ab initio*, so that we may give the public the benefit of all the great advances which have been made in the construction of telegraph instruments.

Ever since the telegraph has been open to the public, the number of messages sent by it have been, as might have been predicted, continually on the increase. If we can succeed in lowering considerably the present high price of the telegram, who can doubt that the number would be correspondingly multiplied? The postal system, which is of a character essentially similar to that of the telegraphic system, shows us what we may fairly anticipate. Since the cost of postage was made low, and uniform throughout the kingdom, the number of letters sent by post annually has been increased nearly seven-fold, being 82,470,596 in 1839, and 600,000,000 last year! Now, what we desire is to imitate this progress (proportionately) in our telegraphic system; and to do this it is only necessary, we are persuaded, first to make the cost of a message low, say a *shilling* for fifteen words, and next, to make this cost uniform for messages sent to any part of the kingdom.

Now, the question arises—can a telegraphic system be so established throughout the United Kingdom as to render a uniform shilling message remunerative? We answer, without doubt. But such a system must embrace many novelties. It must for example, be so arranged that the mechanical manipulation of the instruments shall approximate much more nearly than at present to the speed of the electrical operations. As telegraph lines are now worked, the capabilities of the wires to transmit electrical impulses are not nearly developed, owing to the comparative sluggishness of our mechanical operations. This defect must be removed; we will show presently how it may be.

The person to whom we are indebted for several most important improvements in electric telegraphs—improvements embracing all that we have just been considering—is Mr. Thomas Allan, C.E., the author of many valuable telegraphic inventions. Mr. Allan has introduced telegraphic improvements which it is impossible to estimate too highly. The first of these which we will mention relates to what are called pole-chargers, or relays. A great difficulty with these has hitherto been the derangement caused by the action of the spark upon the delicate contact points of the relay. Now, this evil Mr. Allan has got rid of altogether, by combining an improved relay with an improved recording instrument, in such manner that the spark is not produced in the relay at all, but in the recording instrument, where it is of far less consequence. This improvement is attended by an immense advantage, for, now that the relay is relieved of the spark, the limit which has hitherto been practically placed upon the power of the local battery is removed. In Mr. Allan's recording instrument, every current makes a sign, as the relay does not require an opposite current to put it in position to print the next mark, as is generally done, nor does it need any spring or weight to bring it to a position in which the local circuit may be cut off; the printing magnet does that. This magnet also draws through the paper on which the message is to be received while (and only while) the signalling is continued. The new sending instrument by Mr Allan is of a similarly automatic character, all that is necessary being the mere putting of the message (that is, a perforated strip of paper) in the machine.

By the improvements thus far described, the whole progress of sending and receiving messages is made immediately and solely dependent upon the electrical impulses. The electricity performs all itself, neither the hand nor the brain of man being required to interfere. This is a great improvement. The old system, in which the speed at which the hand and the brain of the operator can work rigidly limits the speed at which messages are sent. Mr. Allen might, therefore, have stopped at this point with satisfaction; but he has fortunately chosen to go beyond it, and invented a machine for preparing the message—that is, the perforated paper before spoken of—in a ready and rapid manner. It is clear that by multiplying the number of operators employed, these perforated messages may be produced as rapidly as the electrical instruments can transmit them.

The economy which must attend the introduction of the foregoing improvements is very great. The rate of telegraphing will be increased from two to three-fold, whilst the operation will be reduced to a mechanical one merely, and so secure the economy of machine work as compared with manual or skilled labour; moreover, the apparatus being thus rendered automatic, the primary cause of the mistakes and blunders which are now so much complained of will be removed. The message will be independent of the fallibility or inattention of the operator; whilst, also, a record of each message sent and received is retained at either end, thus forming a complete check upon both the operator and the machine.

EXPERIMENTS ON AERIAL INSULATION.

Two miles of copper wire were insulated upon about 200 porcelain inverts and terminals on lofty standards, and the ends of both miles of wire led into the experiment-room. The two miles could be used together or separately, as occasions might require. In the experiments on insulation for dynamic electricity, the instrument employed was a very delicate galvanometer, having 30,500 coils of copper wire $\frac{1}{1000}$th of an inch in diameter, covered with silk, and the needle suspended by an unspun silk thread. The instrument made use of to measure the retention of the charge of static electricity was a Peltier electrometer kept in a glass-covered zinc box, supplied with chloride of calcium to avoid humidity. A Daniell's battery (Muirhead's improved) of 512 elements was employed for charging both with static and dynamic electricity. The battery was thoroughly insulated by being suspended by straps of gutta-percha made fast to the rafters of the flooring above, and the electromotive force of the batteries often ascertained during the experiments by means of the Peltier electrometer. The battery being always carefully attended to and insulated, as above described, maintained a very regular amount of tension. On the 10th of August, 1860, the whole of the insulators were cleanly washed, and then dried with towels. As soon as the insulators were thoroughly dried, both wires were tested for insulation for static electricity, but neither would sustain the charge an instant. When tested for the loss of insulation for dynamic electricity, the loss of insulation was 1° and 2°, but a slight shower of rain increased the leakage to 18°, which was again reduced to the original figure as the insulator became dry.

The waves of air, as they passed over the insulators, absorbed each a portion of the moisture, and the passage of these waves, or currents of air, was beautifully displayed by a corresponding wave-like movement of the indicator, showing the progress of drying, and consequently of improved insulation. A drizzling mist acted upon the insulators by decreasing the insulation in a similar wave-like manner. The insulators were again thoroughly wiped with dry towels, and the following tests made:—Temperature of experiment-room, 69°; in the sun, 70°. Loss of insulation for static electricity on both wires, 50° in four minutes. Loss of insulation on dynamic electricity, none. One insulator being thoroughly wetted within and without, the loss of insulation was 6°; on two, 8°; on three, 9°; on four, 11°. These four insulators having again been dried, the current was kept on the wires. No loss was observed, but upon causing a column of smoke to ascend, so as to come in contact with the wires and a few of the insulators, the needles were instantly deflected, and indicated a leakage or absorption of 4°, with a continuous vibrating motion through an arc of 1·5°. The smoke having ceased to ascend, no loss of insulation was further observable on the dial of the instrument. Shortly after three P.M., dark and heavy clouds passed over the neighbourhood; the effect upon the needle was peculiar. It was not what might be called exactly "vibration," but an undulatory motion, now slightly to the right, then to the left, &c. Some of the dark clouds appeared as if they attracted the needle upon their approach, and in receding repelled it; or, in other words, to reduce the tension of the electricity in the wires as they approached by absorption or otherwise, and, as they receded, momentarily to enhance to a small degree that tension. During thunderstorms and lightning the motion of the needle, when under a full battery charge, and in connection with the insulated wire, was generally tremulous—a tendency to "dip" rather than to deflect angularly; but on one occasion, during a heavy thunderstorm in the autumn of 1860, the needle suddenly fell to zero, but instantly regained its original position of 32°. During the course of the day several instances occurred, when the needle suddenly deflected 3° or 5°, without any apparent cause. Ultimately it was traced to the passage across the wires of the steam from the railway locomotives, which passed within a few yards of the suspended wires. Numerous experiments were subsequently made upon the effects of the currents of steam. It was generally found that when dense columns of steam came in contact with the wires or the insulators, a disturbance of the needle took place. The condensation of steam is very slow in some kind of weather, and it has then a greater effect when it has been carried by the wind against the wires along our telegraph lines. It would be an interesting procedure to determine upon some of our long lines the effect of steam upon their insulation, and how far it may be the cause of the capricious deflections of our signalizing needles, which are generally attributed to earth currents, cross contacts, &c. The locomotive at times, during its progress, is in close proximity to the wires; at other times the wires are at a distance, and not liable to be affected, especially when traversing a tunnel in which the wires are wholly insulated, the foot of an embankment, or high elevations. The effect of these irregularities in the relative positions of the locomotive and telegraphic wires might be determined by the corresponding changes in the insulatory condition of the line upon some fine and dry days, as indicated upon a galvanometer. When the suspended wires were charged with static electricity, its absorption by steam was instantaneous. When the steam ascended, and circulated amongst the insulators, it not only wetted the surfaces, but condensed in the inverted hollows, or bells of the insulators, and for a time afforded a ready passage for the fluid to the earth in the same manner as the morning dew moistened the exterior, and the earth's vapoury exhalations the interior, of the inverts or terminal. What is generally designated a "dry fog" had but little effect upon insulation, but a fog charged with moisture affected it much in the same manner as the dew and rising vapours of the morning. Snow deposited upon the surface of the insulator had not the same effect as ice; the ice affects the insulation, inasmuch as it lined the external and internal surfaces of the insulator with a conducting medium; but when the insulators were clean, and free from ice, the insulation was found invariably good in frosty weather. It should, however, be observed here, that in all the above experiments, one end of the wire was always insulated—that is, not in contact with the earth—and that the other end, in testing with *dynamic* electricity, was in contact with the copper pole of the battery.

GILMORE AND PREECE'S SHIP-STEERING TELEGRAPH.

The following remarks on the new ship-steering electric telegraph appeared in a leading article of the *Daily Telegraph* on the 10th instant. This instrument is the invention of Lieutenant A. Gilmore, of Woolston, and Mr. W. H. Preece, C.E., of Southampton:—

We have chained steam to our passenger trains and our goods waggons; we make it spin and weave for us; forge, and trim, and punch the obdurate iron-plates for us; fetch and carry, raise and lower, enormous masses—a passive "slave of the lamp." We have won the lightning down from heaven to run upon our messages, to bring intelligence over wildernesses and under oceans to us from the ends of the earth. Our last achievement now is to impress this domesticated electric spark into the Queen's navy, with the rating of "call-boy." Go on board the Resistance, Hector, Prince Consort, Orlando, or her Majesty's own yacht, and you will see in front of the wheel what resembles a dial-stand, with a plate and movable indicator; on which at night shines a lamp, to make visible the words "steady," "starboard," and "port." Utterly bewildering to the old Benbows and Hoods—strange to the rough sea-dogs who won for us our place upon the waters—would seem this appendage to the fittings of a man-of-war. But they would own the use of it in a raging gale, or when the bustle and noise of action began. A wire passes from the plate to the post of the officer in command, who has but to touch a key-handle, and the needle under the steersman's eye moves to "port" or "starboard," conveying him the order. Lest, for want of the old loud command, he should be thinking of his next allowance of grog or his last sweetheart, and so overlook the message, a gong strikes below the dial at the same moment, and by the number of its sounds he can tell how many points he is to port or starboard his helm; while, should the commander want it put "*hard* up" or "*hard* down"—that is to say, sharply and roundly done—the strokes are given with corresponding rapidity. To appreciate this a landsman ought to have been on board a vessel heeling over in a China typhoon or Mediterranean "mistral," when the captain's or the quartermaster's bellow through the speaking-trumpet is blown into vague breath at its very mouth. He ought to have gone into action with a heavy ship, when all her great guns are roaring at once, and it matters as much as life or death, defeat or victory, to get a turn upon the wheel at the very nick of time. Or he should have made one of a crew by night, when the darkness is so dense that "you can feel it," and when suddenly there glower out of the blackness the lamps of a large vessel bearing down upon the ship, "end on." Without this electric call-boy the all-important word of command must pass—in a gale of wind too, perhaps—from end to end of the deck. It may be misunderstood, mispronounced—the steersman touches the wheel too late, or perhaps wrongly—and the two great hulls come together in the gloom with a crash that brings masts and gear in a tangle atop of the sinking sailors; there are wild shouts, vain efforts, the gurgle of two vast whelming masses, some screams that pierce the night, and—"Lloyd's List" reports months after that the Red Rover and the Mary Jane are "*still missing*." What her Majesty's new naval volunteer Lightning will do in the battles of the iron-clads remains to be seen; but it is hardly possible to comprehend how the cupola-ships, with their ponderous guns and swift antagonists, depending as they must upon twin screws and instantaneous manœuvres, could wage the new warfare successfully without some such aid.

But we like better to contemplate the peaceful uses of these great gifts of science; for towards peace and the happy future identification of the interests and energies of all nations these gifts undoubtedly tend. Do we reflect enough upon what science has done for us, and is doing every day, to render life nobler, higher, more benign, and less mechanical? Is the truth sufficiently grasped, that the daily existence of the artisan or middle-class worker among us is, in a thousand things, incomparably more luxurious through science than that of the nobleman or monarch in what we call, with more conventionality than truth, the "good old times?" Science, and her sister Commerce—the twin earthly angels of human fate—are always working to substitute the machine for the slave, the forces of nature for the aching muscle, the strong action of steam and the swift flash of electricity for the ancient and tedious agents of labour and locomotion. In hundreds of instances, the reader of these very lines can be the witness. He has, if he is tolerably well off in the world, risen to a breakfast table towards which, though

but modestly furnished, the four quarters of the world have contributed their tea, sugar, silver, cloth, condiments, and utensils. Instead of rushes under foot, his slippers have rested on a carpet that, in King John's time, would have bought a baron's estate for its marvellous manufacture. On his table lies this journal; printed at a speed inconceivable until the dazed eye has actually witnessed its fluttering thousands flying off the cylinders. James Watt made it possible for him to read the news of all the world as regularly as he munches his muffins; and Wheatstone enabled us to bring it for him from India, America, Denmark, the Danube; so that Ariel's girdle is put round the world in his daily experience. Hydraulic engineering has given him, at a finger's touch, his bath and the water for his toilette, instead of sending his household far out of doors, as in Asia, to the tank or the well. He throws himself into a comfortable carriage, and steam's tireless arm drags him, at a speed which makes the coaching days ridiculous, to his business or office. There, if he has a parcel to deliver hurriedly, the Pneumatic Despatch Company will shortly puff it for him like a pea from one end of London to the other; and if affairs necessitate a message to the further side of Europe, or domestic arrangements make it needful to say something about dinner or the babies, a small blue spark flashes through space for him, and his wish is known as soon as conceived. The paper he writes upon, the gas-lights by which he writes, the book he takes home, the engraving after Landseer or Millais that catches his eye on the way and leaves a thought of beauty in his mind—the *now* commonest objects of his every-day life, with which not only would he not dispense, but without which existence seems inconceivable—are the gifts of science to this his present day. They have insensibly embellished and elevated his daily duties and labours; they have made Nature the helpmeet, instead of the mystery and Mumbo-Jumbo of his world; they have raised labour many stages above the senseless service of machinery. He cannot walk, or sit, or travel, or work, or communicate with his fellows, but there are helps for him to everything, that demonstrate what the silent closet of the philosopher is doing, and has done, for the ever-widening destinies of man.

Signs are not wanting, too, that a vast development of these benignant aids to human life is approaching. A cautious induction from optical experiments has lately ended in disclosing to us something of the structure of the sun and planets, and even the fixed stars, although so far off that a fractional difference in the rate of light's velocity sets these bodies nearer or more distant by tens of millions of miles. Photography, which has made the same sun our portrait-painter upon cheaper terms than any peripatetic silhouette-cutter, and with finer detail and truth than the best ivory miniatures, seems to be trembling on the verge of producing colour, as well as light and shade. Comparative anatomy, enriched by the products of incessant travel, at least approaches to the solution of the absorbing problem of man's origin. Geography is gradually mapping out the earth for us, though the honours which are showered on courtiers are denied to the discoverers of the fountains of the Nile. Yet, recognised or unrecognised, Science pursues her patient toil, and "knowledge increases." Were this merely a material gain, it would be less important. Science, however, is not the enemy, but the true and faithful handmaid of real religion, and raises us higher only to show how boundless and beautiful is God's universe—how fair the capabities of creation—how noble the prospects of humanity, how grave its duties—how adjusted and fitted to the one great work of moral development is every object and combination among the things which surround us. And though the highest wisdom will still most often teach us our utter ignorance—though the best adornments and greatest alleviations of life will still throw into sharper and more painful contrast its inequalities, injustices, and miseries—yet to have so much is to be promised so much more. Eternally the circles of Divine influx widen upon the sea of human life, and new angels "trouble the water" with stronger and more health-giving impulses. Knowledge breeds knowledge—invention, invention; and their use and exercise a growing tendency to peace. Bigotry opposes it; men's vices and prejudices delay it; ambitious dynasties stand in its way; and the voices that proclaim it are few, and often silenced by selfish policies and ignorant wit; but the days approach—though distant, perhaps, by centuries—when even here there will be "no more war," and man's life be made consistent with his glorious capabilities.

REDUCTION OF TARIFFS.—The highest charge for a message of twenty words to any town in the United Kingdom is three shillings. The reduced charges came into operation on the 7th instant.

ELECTRICAL DISCOVERIES.

I.

A SHORT account of the various discoveries in the science of electricity which took place in the seventeenth and eighteenth centuries, we presume, will not be uninteresting to our student readers. It will be seen how the progress of science prepared the way for the more glorious and magnificent discoveries of the nineteenth century, resulting in the realization of the electric telegraph and its wonderful capabilities, as evidenced in our time, in the transmission of intelligence, both by sea and land, between the nations of the civilised world.

In the year 1600 William Gilbert, a native of Colchester and a London physician, published a Latin treatise, "De Magneto," having discovered that sulphur, wax, resinous substances, glass, and precious stones, when dried and rubbed a little, were endowed with the property of attracting and repelling straws and other light substances.

In 1630 Nicolaus Cabœus, at Terrara, repeated Gilbert's experiments, and made some progress, increasing the list of electrics; as also did Mr. Boyle in the year 1670. He made some discoveries which had escaped the observation of those who preceded him. Contemporary with Mr. Boyle, Otto Guericke, burgomaster of Magdeburg (inventor of the air-pump), made some advances. He constructed a sulphur globe, which he mounted upon an axis in a wooden frame, and causing it to revolve, at the same time rubbing the globe with his hand, performed a variety of electrical experiments. He was the first to discover that, a body once attracted by an excited electric, was repelled by it, and not again attracted until it had touched some other body. He observed the light and sound produced by the electric fluid while turning his electrical machine. Dr. Wall, about the same time, observed the light and sound produced by rubbing pieces of amber with wool, and also experienced a slight shock. He compared the sound and light of the electric fluid so produced to thunder and lightning.

Sir Isaac Newton also engaged in similar experiments in electricity, and was the first in 1673 to discover that excited glass attracted light bodies on the side opposite to that on which it was rubbed, and gave an account of his experiments to the Royal Society in 1675.

Mr. Hauksbee, whose writings are dated 1709, distinguished himself by experiments and discoveries in electrical attraction and repulsion, and electric light. He constructed an electrical machine, adopting the glass instead of the sulphur globe. He experimented upon the subtilty and copiousness of the electric light, and likewise upon the sound and shocks produced by the fluid. After the death of Mr. Hauksbee the science of electricity made but slow progress, and few experiments were made for twenty years. In the year 1728, Mr. Stephen Grey, a pensioner at the Charter House, commenced his experiments with an excited glass tube. He and his friend, Mr. Wheeler, made a great variety of experiments, in which they demonstrated that electricity may be communicated from one body to another, even without being in contact, and in this way may be conducted to a great distance. Mr. Grey afterwards found that, by suspending rods of iron (which was the origin of metallic conductors) by silk or hair lines, and bringing an excited tube under them, sparks might be drawn, and a light perceived at the extremities in the dark. He electrified a boy suspended by hair-lines, and communicated electricity to a soap-bubble blown from a tobacco-pipe. He electrified water contained in a dish placed upon a cake of rosin, and also a tube of water. He made some curious experiments upon a small cup of water, over which, at the distance of an inch, he held the excited tube. He observed the water to rise in a conical shape, from which proceeded a light; small particles of water were thrown off from the cone, and the tube moistened; and from other experiments he concluded that the electrical power seemed to be of the same nature with that of thunder and lightning. The following is a description of some of the experiments by which the ingenious pensioner arrived at his electrical discoveries:—After attempting in vain to give the power of attraction to metals by rubbing, hammering, and heating, he conceived a suspicion that, as glass when rubbed in the dark communicated its light to other bodies, it might possibly be made also to communicate its power of attraction. He provided himself, therefore, with a glass tube, 3 feet 5 inches long and near 1¼ inch in diameter. The ends of the tube were stopped with cork; and he found that when the tube was excited by friction, a feather was

attracted as powerfully by the cork as by the tube itself. To convince himself more fully, he procured a small ivory ball, which he fixed to a stick of deal 4 inches long, and thrust into the cork; and he found that it attracted and repelled the feather, even with more vigour than the cork itself. He afterwards fixed the ball to a longer stick, and even to a piece of wire with the same success. Lastly, he attached it to a piece of pack-thread, and hung it from a high balcony, when he found that, by rubbing the tube, he enabled the ball to attract light bodies in the court below. His next attempt was to examine whether this power acted as well horizontally as perpendicularly. With this view he made a loop of cord, which he hung to a nail in one of the beams of the ceiling, and ran his pack-thread, which had the ivory ball at the end, through the loop; but in this he found, to his utter mortification, that his ball had lost totally the power of attraction. On mentioning his disappointment to a friend, it was suggested that the cord which he employed for the loop, through which the pack-thread run, might be so coarse as to intercept the electric power. To remedy this they made the loop of silk, which they considered stronger in proportion to its thickness than the former. With this apparatus they succeeded beyond expectation. As they attributed their success entirely to the fineness of the silk of which the loop was made, they thought they would perform still better by supporting the pack-thread by a very fine brass or iron wire; but, to their utter astonishment, the electric power was entirely lost; on the contrary, while the apparatus was suspended by the silk loops, they were able to convey the power of attraction along a pack-thread of 765 feet in length. It was evident, therefore, that these effects depended upon some quality in the silk which disabled it from conducting away the electric power on the hempen cord as the wire had done; and by subsequent experiments this hypothesis was amply confirmed.

Mr. Du Fay, intendant of the French king's gardens, repeated the experiments of Mr. Grey in 1733. He found that by wetting the pack-thread he succeeded better with the experiment of communicating the electric virtue through a line 1,256 feet in length. He made the discovery of two kinds of electricity, which he called *vitreous* and *resinous*; the former produced by rubbing glass, and the latter from excited sulphur, sealing-wax, &c. But this he afterwards gave up as erroneous. Mr. Grey, in 1734, experimented upon iron rods, and gave rise to the term *metallic conductors*. He gave the name, *pencil of electric light*, to the stream of electricity, such as is seen to issue from an electric point. He suggested the idea that the electric virtue of the excited tube was similar to that of thunder and lightning, and that it could be accumulated.

OPINIONS AS TO THE PRACTICABILITY OF DEEP-SEA TELEGRAPHS.

[*Extracted from the Evidence taken before the Government Telegraph Committee.*]

WE desire, however, in conclusion, to observe that we are clearly of opinion that the failures of the existing submarine lines which have been described, have been due to causes which might have been guarded against, had adequate preliminary investigations been made into the question, and we are convinced that, if regard be had to the principles we have enunciated, in devising, manufacturing, laying, and maintaining submarine cables, this class of enterprise may prove as successful as it has, hitherto, been disastrous.—*Member of the Telegraph Committee appointed by the Board of Trade.*

I have no doubt that you can lay a cable in almost any depth of water, if you apportion its specific gravity, and its strength, according to the depth at which it is being laid. * * * So that I think the question of laying cables in deep water, as a question of laying, is not more difficult to solve than the question of laying a cable in shallow water, if the proper mode of construction is adopted.—*The late L. Gisborne, Esq., C.E.*

I think a cable could be laid at 3,000 fathoms. * * * I do not think that a depth of 3,000 fathoms is an insurmountable difficulty.—*Richard A. Glass, Esq.*

I can see no real obstacle to the successful laying and permanent working of an Atlantic cable.—*Captain J. Kell.*

I think that submarine cables can be laid in any reasonable depth of water, say 2,000 or 3,000 fathoms.—*Mr. Willoughby Smith.*

Once in deep water, and the deeper the water the better, the more safe the cable is, in my opinion; and I may say, also, that I feel the utmost confidence in being able to lay a light cable with the greatest possible ease. Almost every nautical man that I have talked to on the subject has said, "If we had only just a very light cable, that could be paid out, like paying-out a log line, there would be no difficulty at all about it."—*J. A. Longridge, Esq., C.E.*

I have very little doubt, from the experience gained by the repeated attempts to lay the Atlantic cable, that if a cable be properly made, and once laid, it must result in permanent success. * * * I am not aware of any inherent difficulties that are not easily surmounted.—*W. H. Woodhouse, Esq., C.E.*

I have no doubt as to the permanency of deep-sea cables, if they are perfectly constructed, and perfectly laid upon a soft bottom, and provided they are worked with proper currents.—*Sir Charles Bright, C.E.*

My opinion is that a cable can be so thoroughly well-made as to last 50 years, if laid down in quiet water, without further expense. —*The late J. W. Brett, Esq.*

I think an iron-wire covered cable can be laid at a depth of a mile and a-half, or between 1,400 and 1,500 fathoms.—*Mr. W. T. Henley.*

I must say it is my entire belief that if you can once properly safely submerge a properly constructed cable in the deep ocean, it will, in all probability, last for hundreds of years.—*George Saward, Esq.*

It did not appear to me that there was any difficulty in paying-out the Atlantic cable, which is now laid; but I think it would be an improvement if a cable of equal strength, and of smaller weight, could be adopted.—*Commander J. Denman, R.N.*

I would not have the slightest hesitation in laying a cable of that size (the Gibraltar cable), made of steel and hemp, in 2,000 fathoms.—*H. C. Forde, Esq., C.E.*

I think as the result of the whole of my experience, that with proper skill, and suitable machinery, either heavy or light cables may be laid in deep water.—*R. S. Newall, Esq.*

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(*Continued from page 127.*)

7. *Automatic Systems for the Transmission of Messages in the Codes described.*

Four distinct plans for transmitting by *automatic mechanism* messages, expressed in the codes already mentioned, are exhibited respectively by—

The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2,978).

Digney Brothers & Co., Paris, M. (France, 1,414).

Siemens & Halske, Berlin, M. (Prussia, 1,413).

T. Allan, M. (United Kingdom, 2,850).

It has long been known that messages might, through most land lines, be received legibly, when the separate signals succeeded each other much faster than a clerk could send them, when each symbol required a separate movement and act of volition on his part. Many plans have consequently been devised for the indirect or mechanical transmission of signals, as opposed to their direct transmission by hand. In all these plans, the message is in some way mechanically represented—for instance, by punched paper or by arranged types; the preparation of the paper, types, or their equivalent is to be carried on simultaneously by several clerks, while the prepared messages are being successively transmitted with great rapidity through a single wire; so that if, say, by the present system the capabilities of a line were 300 messages per diem, it is supposed that by the automatic system, 1,500 or 2,000 messages might be sent through the same wire in the same time, at very slightly increased cost. The possible fallacy of these expectations has already been alluded to, but some of the plans now exhibited are so admirable in conception, and so simple in execution, as to warrant at least a hope that the difficulties alluded to may be successfully overcome. If, indeed, the public could be induced to learn a telegraphic alphabet, and to *prepare their own messages*, the success of the automatic system might be expected with much confidence. Thus, a merchant's clerk might prepare the messages of the firm in the punched paper required for Professor Wheatstone's transmitter; this prepared paper, on delivery at the telegraph office,

would simply have to be passed through the machine when its turn arrived, and the corresponding dotted tape received at the distant station could at once be addressed and delivered to be deciphered by the receiver at his leisure.

The functions of a telegraph company would then be nearly similar to those of the present post-office. The messages of prepared paper received would have to be sorted and transmitted in batches to the several towns by being passed through a machine at one end of a wire, at the other end of which the counterpart would appear. These counterparts would then have to be again sorted, addressed, and sent out as letters are now. Every yard of paper passed through the machine might be charged at a certain rate without any reference to the code, language, or number of words. No great skill would be required to prepare or decipher the message, since these operations could be done leisurely; the functions of the company would be reduced to those strictly essential, and their responsibilities much diminished. Although seeming somewhat visionary at present, it is just possible that some such plan may some day be adopted, and that telegraphic despatches may then be sent as cheaply as letters are now; but so long as companies are required to prepare the messages at one end of a wire, and to write them out fairly at the other end, the writer doubts whether automatic systems will come into general use.

The advantages of the automatic system are very distinctly set forward in a paper by Professor Wheatstone, published in the "Comptes Rendus of the Paris Académie des Sciences." From this paper is mainly extracted the following description of the admirable instrument invented by Professor Wheatstone, and exhibited by the Universal Private Telegraph Company (United Kingdom, 2,978):—

"Long strips of paper are perforated by a machine constructed for the purpose, with apertures grouped to represent the letters of the alphabet and other signs; a strip thus prepared is placed in an instrument associated with a rheomotor (or source of electric power), which, on being set in motion, moves it along, and causes it to act on two pins in such manner, that when one of them is elevated the current is transmitted to the telegraphic circuit in one direction, and when the other is elevated it is transmitted in the reverse direction; the elevations and depressions of these pins are governed by the apertures and intervening intervals. These currents, following each other differently in these two opposite directions, act upon a writing instrument at a distant station in such a manner as to produce corresponding marks on a slip of paper moved by appropriate mechanism.

"The first apparatus is a perforator, an instrument for piercing the slips of paper with the apertures in the order required to form the message. The slip of paper passes through a guiding groove, at the bottom of which an opening is made sufficiently large to admit of the to-and-fro motion of the upper end of a frame containing three punches, the extremities of which are in the same transverse line. Each of these punches, the middle one of which is smaller than the two external ones, may be separately elevated by the pressure of a finger-key. By the pressure of either finger-key simultaneously with the elevation of its corresponding punch, in order to perforate the paper, two different movements are successively produced: first, the raising of a slip which holds the paper firmly in its position; and secondly, the advancing motion of the frame containing the three punches, by which the punch which is raised carries the slip of paper forward the proper distance; during the reaction of the key, consequent on the removal of the pressure, the clip first fastens the paper, and then the frame falls back to its normal position. The two external keys and punches are employed to make the holes, which grouped together represent letters and other characters, and the middle punch to make holes which mark the intervals between the letters.

"There need be no change in the alphabet which is at present employed; the points at one side may represent the short dashes, and those at the other side the long dashes, their order remaining the same as in the existing system.

"The second apparatus is the transmitter, the object of which is to receive the slips of paper prepared by the previously described instrument or perforator, and to transmit the currents produced by a voltaic battery or other rheomotor, in the order and direction corresponding to the holes perforated in the slip. This it effects by mechanism somewhat similar to that by which the perforator performs its functions.

"An eccentric produces and regulates the occurrence of three distinct movements. 1st. The to-and-fro motion of a small frame which contains a groove fitted to receive the slip of paper, and to carry it forward by its advancing motion. 2nd. The elevation and depression of a spring-clip, which holds the slip of paper firmly during the receding motion, but allows it to move freely during the advancing motion. 3rd. The simultaneous elevation of three wires placed parallel to each other, resting at one of their ends over the axis of the eccentric, and their free ends entering corresponding holes in the grooved frame. These three wires are not fixed to the axis of the eccentric, but each end of them rests against it by the upward pressure of a spring, so that when a light pressure is exerted on the free ends of either of them, it is capable of being separately depressed. When the slip of paper is not inserted, and the eccentric is in action, a pin attached to each of the external wires touches, during the advancing and receding motions of the frame, a different spring, and an arrangement is adopted by means of insulation and contacts properly applied, by which, while one of the wires is elevated and the other remains depressed, the current passes from the voltaic battery to the telegraphic circuit in one direction, and passes in the other direction when the wire before elevated is depressed, and *vice versâ*; but while both wires are simultaneously elevated or depressed, the passing of the current is interrupted. When the prepared slip of paper is inserted in the groove and moved forward, whenever the end of one of the wires enters an aperture in its corresponding row, the current passes in one direction, and when the end of the other wire enters an aperture of the other row, it passes in the other direction. By this means the currents are made to succeed each other automatically, in their proper order and direction, to give the requisite variety of signals. The middle wire only acts as a guide during the operation of the current.

"The wheel which drives the eccentric may be moved by the hand, or by the application of any motive power.* Where the movement of the transmitter is effected by machinery, any number may be attended to by one or two assistants. This transmitter requires only a single telegraphic wire.

"The third apparatus is the recording or printing apparatus, which prints or impresses legible marks on a strip of paper corresponding in their arrangement with the apertures in the perforated paper. The pens or styles are elevated and depressed by their connection with the moving parts of the electro-magnets. The pens are entirely independent of each other in their action, and are so arranged that when the current passes through the coils of the electro-magnet in one direction one of the pens is depressed, and when it passes in the contrary direction the other is depressed; when the currents cease, light springs restore the pens to their elevated point. The mode of supplying the pens with ink is as follows:—A reservoir about an eighth of an inch deep, and of any convenient length and breadth, is made in a piece of metal, the interior of which may be gilt, in order to avoid the corrosive action of the ink placed in it; at the bottom of this reservoir are two holes, sufficiently small to prevent, by capillary attraction the ink from flowing through them; the ends of the pens are placed immediately above these small apertures, which they enter, when the electro-magnets act upon them, carrying with them a sufficient charge of ink to make a legible mark on a ribbon of paper passing beneath them. The motion of the paper ribbon is produced and regulated by apparatus similar to those employed in other register or printing telegraphs. These instruments will transmit from 500 to 600 letters per minute through resistance coils."

The transmitter very slightly modified may be used with the usual Morse receiving instruments, and 166 letters per minute were, on a trial, correctly sent with a battery of 120 cells through a circuit of 324 miles of land line, passing from London to Bristol, Bristol to Birmingham, and Birmingham to London. Two distinct earth-plates were used in this trial, and there is reason to believe that the speed was limited rather by the inertia of the moving parts of the receiving instrument than by any inductive influence on the line. The most expert clerk could not transmit more than from 117 to 123 letters per minute. The advantages of the system are pointed out by Professor Wheatstone in the same paper in the following remarks, which are more or less applicable to all good automatic systems:—

"Whatever practical dexterity may be acquired by a voluntary

* "Instead of a voltaic battery, a magneto-electric machine or an electro-magnetic machine may be employed as a source of electric power. In this case, the transmitter and the magneto-electric, or electro-magnetic, machine form a single one, apparently moved by the same power. They are so adapted to each other that the shocks or currents are produced at the moment the pins of the transmitter enter the apertures of the perforated paper."

operator, the result arrived at will be far inferior to that obtained by the automatic process, which is only limited by the rapidity with which the recurring motions of the transmitter can be effected.

"For very considerable distances this rapidity may be limited in conductors subjected to inductive influences by the tendency which rapidly recurring short currents have to coalesce.

"But even if there were no advantage in point of rapidity possessed by the automatic over the voluntary process of transmission, its other advantages would be incontestable. For the profitable working of a telegraphic line, it is necessary that the operator should manipulate as rapidly as is consistent with a correct transmission of the message; it requires great skill to become a proficient in such manipulations, even when the language in which the despatch is sent is quite familiar to the operator; but if he would send a despatch in a language unknown to him, or in cipher, he is obliged to proceed with caution and slowness. In my new system, the prepared messages are transmitted with equal rapidity in whatever language or cipher they may be; and as the perforated bands may be prepared at leisure, and be subjected even to the revision of a corrector, guarantees of accuracy are obtained which cannot be afforded by the system of immediate voluntary transmission. Several clerks will be required to prepare messages for a single telegraphic line in constant activity; but in an economical point of view their time is of far less importance than the time occupied by the transmission of a message.

"Another advantage this system possesses is, that the same prepared message may be transmitted through any number of distinct lines, if not simultaneously, at least in such rapid succession as to be equivalent thereto; and besides, without any fresh labour, the same message may be retransmitted if thought necessary; and service messages in constant use may be preserved for transmission whenever they may be required.

"Were an automatic system generally adopted it might, in many instances, be more convenient to prepare the messages at the offices from which they are sent, the instrument for effecting this purpose being very portable and of small cost. The operations at the telegraph office would in these cases be limited to passing the perforated band through the transmitter at one station and receiving the printed message at the other, the translation, as well as the preparation of the message, devolving on the department of the administration to which it relates."

(To be continued.)

REPORT OF THE DIRECTORS OF THE ATLANTIC TELEGRAPH COMPANY.

The directors herewith present to the shareholders an audited balance-sheet, showing the receipts and disbursements of the Atlantic Telegraph Company from its commencement in 1856 to the end of December, 1863.

During the past year the board has been constantly engaged in completing the financial arrangement for a renewal of this undertaking, and in promoting such investigations and experiments as appeared desirable, in order to secure every practicable improvement in the structure of the future cable.

To advance the latter object, the board issued an advertisement in August last, inviting tenders for a cable suitable for laying across the Atlantic Ocean, and with a view to leave invention entirely unfettered, they abstained from any dictation as to the form or materials to be adopted, merely stipulating for a working speed of eight words per minute.

In reply the board received tenders and numerous specimens of cable and materials. They were at once submitted to the distinguished gentlemen who have throughout so materially assisted the directors by their valuable advice as a scientific consulting committee. This committee, after examining the tenders and causing the specimens to be tested at the works of Mr. W. Fairbairn, unanimously recommended the board to adopt the tender of Messrs. Glass, Elliot and Co., and the general principle of their proposed cable, but advised that before settling the final specification every portion of the material to be employed should be carefully tested, both separately and in combination, so as to ascertain what improvements could be effected either in their quality or in the method of applying them.

Messrs. Glass, Elliot and Co. at once consented to provide material and manufacture specimens, in order to carry out the wishes of the board and of the committee in this respect. Various lengths of cable were tested at the Canal-street works, at Manchester, under the superintendence of Mr. Fairbairn and Mr. Whitworth, and in the presence of the secretary of this company. At the latter place also experiments were separately made upon different qualities of the metal and hemp composing the external protection of the cable. The particulars of all these labours were embodied by Mr. Fairbairn in a statement submitted to his colleagues, whose deliberations thereon resulted in the final report which has been adopted by the board, and is printed herewith for the information of the shareholders, as is also the general specification of the cable, therein unanimously recommended by the committee.

The directors here desire on behalf of themselves and the shareholders to record their feeling of sincere obligation to the members of the scientific committee for their most important and gratuitous services to this undertaking.

The financial position of the company already alluded to, has long and seriously occupied the attention of the board, but they expect now to have the gratification of being enabled to announce at the extraordinary meeting, of which due notice has been given for the 31st instant, that the difficulties of the company in this respect have been removed.

The board regret to report the recent decease of Sir William Brown, Bart., and of Mr. John Watkins Brett, two of the directors of this company.

It is not at present proposed to fill up the vacancies thus created.

The directors retiring by rotation at the present meeting are Mr. George Peabody, Mr. Francis Le Breton, and Mr. John Pender, M.P., all of whom are eligible, and offer themselves for re-election.

The honorary directors in America who retire at the present meeting are, the Hon. George Cartier and the Hon. John Robertson, who, being disqualified, are at present ineligible, and Mr. Watts Sherman and Mr. Cyrus W. Field, who offer themselves for re-election.

The retiring auditor is H. W. Blackburn, Esq., who offers himself for re-election.

This report would have been issued earlier, but for the present non-completion of pending negotiations, the details of which it has been found impossible to conclude in time to lay them before the meeting.

James Stuart Wortley, *Chairman.*
George Saward, *Secretary.*

London, 15th March, 1864.

Report of the Scientific Committee, appointed to consider the best Form of Cable for Submersion between Europe and America.

With a view to determine the most eligible cable for submersion across the Atlantic, we have considered and discussed the results of the numerous experiments that have been made upon the samples of cable supplied to the Atlantic Telegraph Company, in answer to their advertisement, and upon improved specimens prepared subsequently for our examination by Messrs. Glass, Elliot and Co.

We consider the cable No. 46, prepared by Glass, Elliot and Co., to be the one most calculated to ensure success in the present state of our experimental knowledge respecting deep sea cables, and we accordingly recommend the directors to adopt that cable as described in the annexed specification thereof.

We further recommend that the following precautions be adopted during the manufacture by the Gutta Percha Company, and by Messrs. Glass, Elliot and Co. respectively.

That the conductivity of the wire should be determined by the specification at a high standard, to be fixed by the electrical advisers of the company, but at not less than 85 per cent.

That the electrical perfection of the core be determined by the unit system of measurement, and that the standard of the cable should certainly not be below that of the best cable hitherto made.

That the core of the cable be tested under hydraulic pressure, and at the highest pressure attainable in Reid's tanks now at the Gutta Percha Works.

That after submission to this pressure the core be carefully examined, and before it be transferred to Messrs. Glass, Elliot and Co., it be required to pass the full electrical test under water.

That all the tests of the core be made in water, of a temperature of 70° Fahr., and after twenty-four hours' submersion therein.

That the company, as well as Glass and Co., employ proper persons at the Gutta Percha Works to check the electrical tests, and it is

desirable that they should arrive at their results by a different process to that employed by the Gutta Percha Company.

That the completed cable be continuously tested under water at such temperature as the electrical advisers of the company decide on from time to time, and that the company check the tests.

That the joints be tested separately, and that no joint be passed which shows a leakage twice as great as that of a corresponding length of the core.

That careful and frequent mechanical tests be made upon the iron wire and hemp, and that the company, as well as the contractors, keep properly paid and respectable persons on the wire-drawers' premises, as well as at Messrs. Glass, Elliot and Co.'s works, to check the strength and elongation of these materials.

Signed DOUGLAS GALTON.
WM. FAIRBAIRN.
WM. THOMSON.
C. WHEATSTONE.
London, 31st October, 1863. JOSEPH WHITWORTH.

The following is an illustration with a description of the new cable approved of by the scientific committee, and referred to in their Report of the 31st October, 1863 :—

The Conductor consists of a copper strand of seven wires (six laid round one), each wire guaging ·048, or No. 18 of the Birmingham wire-guage, and weighing 300 lbs. per nautical mile, embeded for solidity in the composition known as "Chatterton's Compound." The Insulator consists of gutta-percha, four layers of which are laid on alternately with four thin layers of Chatterton's compound, making a diameter of the core of ·464 inches, and a circumference of 1·392 inches. The weight of the entire insulator is 400 lbs. per nautical mile. The external protection is in two parts; first, the core, surrounded with a padding of soft jute yarn, saturated with a preservative mixture; next to this padding is the protective covering, which consists of ten solid wires of the guage ·095, drawn from homogeneous iron, each wire surrounded separately with five strands of Manilla yarn, the whole of the ten strands thus formed of the hemp and iron being laid spirally round the padded core. The weight of this cable in air is 35 cwt. 3 qrs. per nautical mile, the weight in water is 14 cwt. per nautical mile; the breaking strain is 7 tons 15 cwt., or equal to eleven times its weight per nautical mile in water, that is to say, if suspended perpendicularly, it would bear its own weight in eleven miles' depth of water. The deepest water to be encountered between Ireland and Newfoundland is about 2,400 fathoms, and one mile being equal to 1,014 fathoms, therefore 1,014 × 11 = $\frac{11154}{2400}$ = 4·64, the cable having thus a strength equal to 4·64 times of its own vertical weight in the deepest water.

The following particulars are appended, in order that a comparison may be made between the structure of the new and old cable :—

Conductor, a copper strand, consisting of seven wires (six laid round one), and weighing 107 lbs. per nautical mile. Insulator, gutta-percha laid on in three coverings, and weighing 261 lbs. per knot. External protection, eighteen strands of charcoal iron wire, each strand composed of seven wires (six laid round one), laid spirally round the core, which latter was previously padded with a serving of hemp saturated with a tar mixture. The separate wires were each 22½ guage, the strand complete was No. 14 guage. Weight in air 20 cwt. per nautical mile. Weight in water 13·4 cwt. per nautical mile, or equal to 4·85 times its weight in water per knot; that is to say, it would bear its own weight in a little less than five miles depth of water. Breaking Strain, 3 tons 5 cwt. Deepest water to be encountered, 2,400 fathoms, or less than 2½ nautical miles in depth. The Contract Strain was equal to 4·85 times its weight per nautical mile in water. One knot being in fathoms = 1,014 × 4 = 4 $\frac{4918}{2400}$ = 2,05 times the strength requisite for the deepest water.

ATLANTIC TELEGRAPH COMPANY.

THE seventh ordinary annual meeting of the shareholders of this company was held at the London Tavern, on Wednesday last, the 16th instant, the Right Hon. James Stuart Wortley, chairman of the company, presiding.

The SECRETARY having read the notice calling the meeting, then proceeded, at the request of the chairman, to read the report.

It having been agreed to take the balance sheet as read,

The CHAIRMAN said that it gave him peculiar pleasure, in meeting so many of the shareholders on that occasion, because it convinced him that the interest in their great enterprise was in no degree abated; indeed, it would be strange if it were so; for after what they had already done, they now looked forward with boldness to success, seeing that they had arrived so near to the point of the accomplishment of their great work. He expected to have been able to disclose to them on that occasion important matters in connection with their great undertaking, but owing to unavoidable circumstances he was prevented from doing so, it having been found impossible to bring the details concerning the laying of the cable before that meeting; therefore, when he had gone through the business, he should ask them to adjourn till the 31st of the present month, by which time all the legal instruments would be signed, and he should be able to tell them all about it. He must now congratulate them on the state of their balance sheet, although not what he expected it would have been; still it was better than they had been able to present before, for they had a balance in hand of £61,245, which from fortunate chances they had been able to realize. It was said, that which was one man's meat was another man's poison, and so it had turned out with them, that whilst money had been very scarce, and many things had been restricted in consequence, the directors had been able to realize interest at the rate of from 6 to 8 per cent., and, as was stated in the balance sheet, they had now a balance of £61,245, which was a most satisfactory state of things, but which he hoped would eventually be very largely increased. Some present would do him the honour to remember, that in December, 1862, he stated that they had made arrangements to have the assistance of several scientific gentlemen, to consult and advise as to the best specimen of cable which they could have to carry out the objects of the company, and they had found the greatest willingness on the part of these distinguished gentlemen to assist them in arriving at a proper conclusion. Having advertised in August last, for specimens of cables, and left the manufacturers entirely free to adopt any form or materials they might please, merely stipulating for a speed of eight words per minute, they received seventeen specimens and tenders, through all of which these gentlemen very carefully went, and he was sure that when he informed them that the council consisted of Captain Galton, in connection with her Majesty's government, Mr. W. Fairbairn, Professor Thomson, Professor Wheatstone, about the oldest electrician of the day, and Mr. Whitworth, whose name was a household word, they would feel certain that great care had been taken in arriving at a conclusion. It had often been a reproach of scientific men that they rode their own hobby, to the exclusion of all others, and it was often too true; but it had not been so in this case, and after a great deal of gratuitous labour, careful deliberation and testing, these five gentlemen came to the unanimous resolution, that out of the seventeen specimens sent, that of Messrs. Glass & Elliot was the most suitable, and the directors thereupon resolved to have it; at the same time determining, previous to a final arrangement, to have each portion of the material employed carefully tested, so as to ascertain whether any improvements could be made either in their quality or the mode of applying them, all of which took place under the superintendence of Messrs. Fairbairn and Whitworth. As the contract is not quite completed, the directors did not feel at liberty to go further into particulars; they expected it to be signed in a few days, however, as it was now in the hands of the lawyer to complete, but as there might be some little delay in this, as lawyers were not proverbial for punctuality in these matters, they proposed to meet again on the 31st instant, in order that every thing might be certain of completion, when the directors again meet the shareholders. There was one thing he must explain, although perhaps it might be hardly necessary: some of them had by that time received a note, informing them of a call of 30*s*. per share. It was on account of the perfect confidence they have in the success of their undertaking, that the directors had made this call. They had been reproached in some instances, by being asked, why they did not call their money in, so as to set their affairs in a proper position; but it was not made payable till the 7th of April, which would be subsequent to the meeting, at which he hoped to show them that their financial difficulties had been overcome. He was not aware that he had any thing more to dwell upon, he would merely urge upon them all, as far as their engagements would permit, to be present on the 31st instant, and to bring all their friends with them who take an interest in the company, as matters of importance will be communicated on that occasion. He would not sit down without saying how grateful he felt to his colleagues for the kind assistance they had rendered him throughout the year, for at one time his health was such as rendered him totally incapable of attending to his duties; he was thankful, that now his health was restored, and he should devote himself anew to the affairs of the company; the deputy chairman's labours had been unwearied, and to him and his friend Mr. Cyrus Field, who had crossed the Atlantic thirty-one times in the interests of the company, he felt deeply indebted. He was proud to meet on the past evening, collected around the tables in

that room, a large number of distinguished persons, merchants and capitalists, who had assembled to do honour to that gentleman. It was peculiarly gratifying to see an American so surrounded, to celebrate the approaching completion of their noble undertaking. He would now move, "That the report now read, and the statement of accounts thereto annexed, be and they are, hereby received and adopted by this meeting."

CURTIS M. LAMPSON, Esq., Vice-Chairman, having seconded the proposition, it was put to the meeting and carried unanimously.

In reply to a question, the CHAIRMAN stated that the negotiations for the cable, for the laying, and for the ships would all be included in one contract.

The CHAIRMAN then proposed, "That the directors retiring by rotation at the present meeting, viz., Mr. George Peabody, Mr. Francis Le Breton, and Mr. John Pender, M.P., be re-elected directors of the Atlantic Telegraph Company," which having been seconded by Mr. EDWARD CROPPER, was put to the meeting and carried unanimously.

The CHAIRMAN next proposed "That the Honorary American Directors retiring by rotation at the present meeting, viz., Mr. Watts Sherman, of New York, and Mr. Cyrus W. Field, be re-elected Honorary Members of the Atlantic Telegraph Company," remarking that a greater loss could not happen to the management of the company than to be without the assistance and advice of his friend Mr. Cyrus Field at their board.

Captain HAMILTON having seconded the proposition, it was submitted to the meeting, and carried unanimously.

The CHAIRMAN then proposed, "That Mr. Henry Webster Blackburn be re-elected auditor to the Atlantic Telegraph Company."

The motion was seconded by Mr. FRANCIS LE BRETON, and carried unanimously.

C. M. LAMPSON, Esq., then moved, "That this meeting stand adjourned until the 31st instant, to be preceded by a Special General Meeting, at a quarter before one o'clock on the same day."

Mr. LE BRETON seconded the motion, which, having been put to the meeting, was carried unanimously.

The thanks of the meeting to the Right Hon. James Stuart Wortley, for presiding on the occasion, having been unanimously accorded, that gentleman briefly acknowledged the compliment, and the meeting adjourned.

THE ROYAL SOCIETY.

GENERAL SABINE, the President of the Royal Society, gave his first *conversazione* this season, on Saturday evening, at the apartments of that learned society, at Burlington House, Piccadilly. There was a very large attendance of fellows and friends connected with the different scientific institutions in the metropolis, together with several foreign celebrities in science. All the saloons thrown open were tastefully adorned by some of the choicest trees, plants, and flowers, lent by the Royal Botanic Society. The suite of apartments was furnished for the occasion with a large collection of philosophical apparatus, instruments, and models of machines in operation of more than ordinary merit, besides numerous sculptures, paintings, drawings, maps, carvings, and other works of art.

These included electro-magnetic telegraph semaphores, in operation, as used in train signalling on the South-Eastern Railway, manufactured by Messrs. S. W. Silver and Co., of Bishopsgate Within; Mr. J. Browning's improved spectroscopes and aneroids, and a new liquid compass, with 11-inch aluminium card, the largest instrument of the kind as yet made; Professor Stokes's handy spectroscopes for examination of liquids; Professor Clark Maxwell's electric bobbin, with vibrating commutator, for determining the declination and dip of the magnetic force; Professor W. Thomson's new electrometer, and reflecting galvanometer, and new spectroscopes, by Elliott Brothers; Mr. Fleeming Jenkin's frictional governor, by which uniform rotary motion can be maintained in wheelwork, driven by varying weights, or subject to varying resistance; microscopes, by Smith and Beck, Powell and Lealand, Murray and Co.; illustrations of M. Vial's process of instantaneous engraving, exhibited by Messrs. Davies and Hunt; "The First Sorrow," a painting, by Sant, A.R.A.; bronzes and mediæval ivories, lent by E. W. Cooke, R.A.; busts by Woolner, Herr Boehm, and Alexander Munro; lilybud, in marble, by E. Davis; plaster models; "The Secret," by Raemacker, and "A Mother's Love," by E. Landseer: statuette of Thackeray, in terra cotta, Boehm; specimens of photo-sculpture, exhibited by Mr. Claudet; statuettes, "Boys at Play," J. Durham; crayon portraits, by G. Richmond; models of the engines of the Agincourt and Octavio, Messrs. Maudslay and Co.; model of the Sultan's yacht Taliah, Mr. J. d'A. Samuda; drawings and plans of the Thames Embankment, lent by the Metropolitan Board of Works; specimens from caves in France, illustrative of the industry of the stone age at the reindeer period, imbedded in breccia, with bones of reindeer, aurochs, and horse, exhibited by Messrs. Lartet and Christy; pigmy fossil elephant of Malta, *Elephas Melitensis*, and reindeer bones of colossal size, from the Gower caves, exhibited by Dr. Falconer; and Gisborne's patent electrical and mechanical engine and steering instruments, giving accurate and instantaneous communication between the captain, the engineer, and the helmsman, exhibited by Messrs. Silver and Co.

THE UNITED KINGDOM TELEGRAPH COMPANY.—The wires of this company were open to Huddersfield in the week, and it is expected that several additional stations will be opened in the course of the month.

CORRESPONDENCE.

TELEGRAPHIC FEATS.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—As my last arrived too late for insertion, please cancel it, and substitute this one. I must apologise for its length—perhaps the interest which the subject evidently creates amongst your readers will compensate for the trouble I am giving you. I had relinquished the idea of again appearing in your columns until I saw, to my surprise, that I was charged with representing the speed of the electric present single needle at 15 words per minute. I have it 25 in my copy of that letter—the error has been inadvertently made in the hurried transcription from my rough copy, and from a category I have of the respective speeds of a variety of old and new instruments. I had, just previous to writing that letter, been a witness to the trial of the single needle electric.

It has been wisely remarked that every expert clerk has an affection for, and is prejudiced in favour of, the instrument he works. This is true almost without exception, and especially when applied to the Electric staff. Out of the many whom I have encountered only one acknowledged the supremacy of the Magnetic Company's single needle; the others adhere tenaciously, and in defiance of facts and vision, to their own opinions. The Magnetic Company have been undervalued, their circuits shortened, their instruments slighted. Nothing magnetic will digest on the stomach of an Electric. There is no occasion for this individual rivalry.

Now, however, is the time to establish, by statement and proof, the superiority of the bell instrument over that of the electric systems, and I thank the two correspondents of last week for their assistance.

I dispute the statement made by "Bon Accord," that the Queen's Speech was transmitted from Aberdeen to Inverness at the rate of 30 words per minute, not accounting for stoppages by minor stations on same circuit. If there were any stoppages that speed was unattainable.

At first I gave "Old Morse Clerk" credit for care and discernment, but a closer scrutiny (he first turned critic) convinces me otherwise. In his first letter he says a uniform rate of 36 words per minute could be maintained on the Morse. In a contemporary journal, it is given, from authority, that one of Bright's speeches, containing 25,000 words, was despatched by a Morse at an average rate of 22 words per minute. This was a feat. Their feats now are no better, and yet he "will not yield the palm in point of speed to bells."

He doubts whether 19 French words per minute could be sent for any length of time on bells. In his next he turns critic, says I condemn the Morse, asks a question illogically and unfairly put, fears that I never saw a Morse instrument, and does not understand the term "yarn" in Morse phraseology. He says a message can be arrested on the instant, appeals to visitors, who are no judges of the *comparative speeds* of instruments, and, in face of an explanatory paragraph in my last, asks why, instead of averaging 35 words a minute the bells don't always attain 50, and closes his letter with a deduction that mine was not impartial, and did not contain facts.

It would take another column of paper to examine these points severally. Will the interested reader go through them again, and notice every sentence? He must concede that they answer themselves, with the exercise of a little judgment. However ignorant "W. H. N." may be of the Morse he is scarcely so inconsistent as his friend at Dover is with the bells; and he knows that a "yarn" means the array of dots required to be given by a Morse sender wishing to correct himself; that a sender cannot be instantly arrested, else why that rule "to stop at the end of every address, &c., in messages, and periodically in news."

I agree that the contest lies between the bells and Morse. The recording properties of the latter however, do not, on home circuits, compensate for the extra speed, the simplicity, and cheapness of the former, the clerk's writing being a sort of record, and all that is required. In point of accuracy they are, I think, about equal.

The electric single needle, when classed in such company, hardly deserves mention, and the double needle is actually, when much used, slower than the Morse, owing to the tiring manipulation. With the speech mentioned before a contest ensued between the two (*see* paper). The double needle very fast at first; at end of half hour both equal; at finish of speech printing much the quickest—average rate of printing, 22 words per minute. A bell clerk would despise this speed.

Taking all the minute particulars into consideration, the bell deserves, and ought, and I hope will have the supremacy amongst the instruments used by the two large companies. I do not admire that principle which would keep in oblivion the fame and recommendations of an instrument which is likely to effect such improvement and good in the mercantile world because it is not owned by the community of which such thinkers form a part.

I refer my opponents to page 126, in No. 12 of this journal, on bells, and will disappear from the scene, after appending this quotation:—"Sir W. O'Shaughnessy, in 1861, reported that the substitution of an acoustic for the Morse tape system effected a saving of £3,000 per annum on the Indian lines, and was accompanied with twofold accuracy. The British and Irish Magnetic Telegraph Company are of opinion that the acoustic system saves them several thousands a year."—I am, Sir, yours truly,

W. H. N.

Stockton, March 16, 1864.

TELEGRAPH CLERKS' PROVIDENT FUND.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—When I accepted the post of chairman at the Magnetic employés' meeting, I little expected it would be the means of involving me in journalistic warfare. However, as such appears to be the case, I must e'en take up the gauntlet, and do my best for those whom I have the honour to represent.

Your correspondent, "A Shareholder," wished to know "a few of the arguments adduced at our meeting, and the principal objections we had to the Telegraph Clerks' Provident Fund." My reply, giving that explanation, has elicited letters from three correspondents, signing themselves "G. Benson," "A Shareholder," and "One of the Least." The first of these gentlemen, after highly eulogising the merits of Miss Oppenheim, says, "In round calculation, the sum of 3d. per week is demanded—not a very exorbitant amount—for which trifling payment we receive, in cases of illness, a weekly allowance of 10s., *and in that of temporary disorder, the best medical advice from a physician, together with assistance from the fund.*"

Mr. Benson has either not yet read the rules, or wholly misunderstood those he has read—as, if he turns to rule 9, he will find these words:—"But no person shall claim pay for any slight accident or illness, which neither confines the patient to the house, requires extra diet, nor causes him or her to experience pecuniary loss."

So much for Mr. Benson's conclusions as to *temporary disorder.*

Again, he says, "It ought not to be grudged that some benefits should fall to the other side. And, notwithstanding the society's late formation, its sick-list is already large, and much greater than was at first expected." Is Mr. Benson financially interested in the fund? As, if so, we may draw our own conclusions as to the benefits he would wish the fund to experience—if not, I should feel obliged if he will explain the benefits he wishes not to be grudged falling *to the other side.* I was not aware, *and certainly do not believe,* the fund was established to benefit its promoters. Your correspondent evidently left his spectacles at home, and laboured under a defective eyesight, when he read the "Report of the Telegraph Clerks' Provident Fund," or he would have seen there are only two members on the sick-list, and that the round numbers should be 4d., instead of 3d., for assurance of 10s. per week during sickness, viz.—3½d. subscription, ½d. per week towards management: this, with incidental fines, &c., would, no doubt, amount to 4d. per week. If your correspondent refers to the last paragraph in my former letter, he will find I did not say the meeting disagreed with the payments: far otherwise—they wished for "*higher subscriptions.*"

With reference to "Mr. Samuel Gurney, Sir Morton Peto," &c., I much question whether any of the patrons or patronesses have even glanced at the rules: they have merely come forward in a just cause—viz., relief to the telegraph clerks—not even waiting to study the technical points introduced into the rules of the fund.

As "A Shareholder" so nearly agrees with my views, I have very little to offer in reply to his second communication, and will content myself by saying, it would be very disagreeable for those clerks living 200 or 300 miles away from home, to have to produce their certificates of birth or baptism, for which they would most probably have to pay the fee of 2s. 6d. It is certainly necessary to produce those documents when insuring on life, but I cannot see that it is at all essential when assuring for sick pay.

As to the rule requiring the magistrate's signature to the medical certificate, I think that might be modified, by making it necessary to obtain the signature of the district superintendent of the company to which the clerk belongs.

"One of the Least"—the writer of the concluding letter in your last week's Journal—has evidently mistaken the reason of my writing my previous letter, and has therefore applied his remarks to me personally.

As he has thought fit to title me "the self-imposed champion of our oppressed and suffering sisterhood," I must, in proof of my determination to uphold that championship, say that it would be mean and paltry in the extreme, for any male subscriber to speak of "injustice," if the fund should ever be called upon to grant sick pay to a female member when visited by illness consequent upon maternity.

The female members might, with the same grace, plead "injustice," when called upon to subscribe for sick pay to a male member suffering from an accident through "cricket," or any other manly sport in which they, the female members, are not in the habit of indulging.

I cry shame against the man who would say it was unfair to allow sick pay, or a certain sum, to the female clerks, under the circumstances mentioned.

"One of the Least" says, "that by some clerical error, the word 'unlawful' has been omitted before 'sports.'" Whether or not your correspondent framed the rules, I cannot say; but as I am unaware of any *unlawful* manly sports or games, I am at a loss to imagine how that word can materially alter the rule or point at issue. Again, he says, "baptismal certificates are not insisted upon, unless some reasonable doubt is entertained of a candidate's statement of age." I do not find these particular words in the book of rules issued by the fund—and here I may mention, the original prospectus was discussed *as it stood,* in its several sentences, and not as altered by your correspondents, who appear to add to those rules the words, they think, are required.

When I referred to the connection of the "Telegraph Clerks' Provident Fund" with the "District Company," I meant merely to call attention to the fact, that Miss Oppenheim, being secretary of the first and superintendent of the latter, might naturally be expected to exercise more influence over her own clerks, being immediately connected with them than over clerks of other companies, and that it was curious she had been unable to obtain more than sixty or seventy members out of 150 to 200 clerks employed by the London District Telegraph Company.

I perfectly agree with all that has been said upon co-operation; and for my part, if I considered the rules of the "Telegraph Clerks' Provident Fund" at all conducive to the clerks' benefit, I would do all in my power to get the Magnetic Company's employés to become members, which, I am convinced, they would do, because like myself they are all "*champions of our suffering sisterhood,* and would only be too glad to belong to a society where they would be brought into the company of their fair sister-clerks, thus, mayhap, securing a foundation for the realisation of one of those "happy events" which would lead to "the necessity of forming a special subscription" which "One of the Least" appears to advocate.

I will conclude with one more question, which, I hope, will finish this useless controversy. If it was known a society was about to be formed for the relief of telegraph clerks, why did not the promoters call a special meeting of that particular body, and submit to that meeting the proposed rules and regulations *before being sent to the Registrar to be certified,* and not call a meeting after they are signed and cannot easily be altered?

This is what should have been done, and which would have prevented all discussion and unnecessary correspondence.

Heartily thanking "One of the Least" for his supplying me with a title
I am, Sir, yours very faithfully, GEO. C. NEWBURY,
"*Champion of our suffering sisterhood.*"

58, Threadneedle-street, March 16, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Mr. Benson, of the Submarine Company, having taken upon himself the championship of the "Provident Fund," will you kindly allow me to ask him, through your columns, to what cause we must attribute the fact of his not having joined it?—Yours faithfully, — — - - — —.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Would any practical telegraphist please inform me, if on a wire of 180 miles in length, with a station at each end, there is a loss about twenty miles from one end of it, which station would get the strongest signal provided the battery power at each end was alike? My idea is, that the station nearest the fault would get the strongest signals.—Yours, &c. K. H.

TELEGRAPHIC NEWS.

OTTRANTE AND AVELONA CABLE.—It is determined to complete the submergence of the above cable in the month of April next, when it is to be hoped that the fine weather which generally exists between those coasts about that period of the year will enable those engaged to lay the remainder of the cable successfully.

A LIGHT-SHIP FOR THE ATLANTIC.—A project of a novel and important character has been for some months past under discussion; and we are informed that a company is now in course of formation, with a view to place the proposal in a practical shape. It is intended to station, fifty miles west of Scilly, a ship bearing a floating light, containing stores of provisions, and connected by an electric cable with the shore. It is considered that thus early news may be conveyed, homeward ships may receive their orders whilst at sea, and much suffering, privation, and loss of life be prevented. The work is to be carried out by Moore's patent for an improved method of anchoring ships, and attaching electric cables. The idea is seriously entertained, and, if carried out, might prove of much commercial value. We should be sorry to pronounce it to be impossible, or to throw an obstacle in the way of its accomplishment; but if Moore's patent can securely moor a vessel amid the wild waves of the broad and deep Atlantic, and can secure easy communication at all times with passing ships and with the shore, the invention must be ranked as one of the most marvellous of the age.

THE MALTA AND ALEXANDRIA CABLE.—The steamer Fanny Lambert returned to Malta on the 23rd ult., having been compelled so to do in consequence of some displacement of the cable, caused by stormy weather which she unfortunately met with. H.M.S. Surprise called in at Benghazi on Saturday afternoon; but, after two hours' stay, left for Tolmeitah, in the vicinity of the locality where the fault is supposed to exist, and where the Fanny Lambert expected to meet her on the following Wednesday morning, for the purpose of restoring telegraphic communication on the Alexandria-Benghasi section of the line. We are glad to state that the Fanny Lambert has made good all the derangements which occurred to the cable on board during the late trip, and left this morning for Tolmeitah. It is very satisfactory to know that not the least damage occurred to the cable or machinery on board this vessel, and that confident hopes are entertained of a speedy restoration of this telegraphic line. The greater the difficulties that are overcome, the greater will be the merit due to all members of the expedition.

THE MALTA AND ALEXANDRIA CABLE.—It is reported that intelligence is hourly expected of the complete restoration of the Malta and Alexandria cable. We sincerely trust that the report will prove correct, as this line of telegraph is of the utmost importance to the commercial world.

THE PERSIAN GULF SUBMARINE CABLE.—No further information has reached us than we have already published, of the progress which has been made in laying the remaining sections of the above cable. The next Bombay mail is due, we believe, next Monday; but should success attend the endeavour to submerge the sections to Shat-al-Arab at the head of the Gulf, intelligence may reach us at any moment, as there are land lines from thence to Constantinople and England. Some doubts seem to exist as to the condition of the land lines between Bussorah and Bagdad; and if not available, we must look for further information with respect to the operations in the Persian Gulf per the Bombay mail, as already observed.

THE MEASUREMENTS OF THE VELOCITY OF PROJECTILES.—Mr. George E. Newman, of the Electric and International Telegraph Company, Manchester, has contrived an apparatus for ascertaining the velocity of projectiles, which was put into practical test at Liverpool during the last week. It has been very highly spoken of in the *Times* and other journals for its efficiency for the purpose.

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY obtained leave from the Grand Jury of the county Down, on Wednesday, to lay wires along the high road. The agent of the company stated that they were going to carry their line to the seaboard, and thence across to the Scottish coast.

DR. ESSELBACH.—We insert the following extract from a private letter received from Bombay, communicating the sad and melancholy death of Dr. Esselbach. The deceased had long been connected with telegraphy, both in England and abroad, and was distinguished for his profound mathematical acquirements and electrical knowledge. "It may be that I am the first to convey to you the following sad intelligence. Dr. Esselbach, who, from the outset, took a very lively interest in the laying of the cable, had a fever for three days, and (as we suppose) in the delirium of the fever put an end to his own existence, by jumping overboard. At present we know very little of the circumstances, our information being derived exclusively from a telegram from Col. Stewart, announcing the fact. Dr. Esselbach, whose acquaintance I had but just formed, seemed to be a gentleman of a particularly amiable disposition, and possessed of a very delicate nature. His health, when in Bombay, was apparently good. His untimely death has cast a gloom over us all, and we are, at present, entirely uninformed as to what changes in the staff may result from it. The first portion of the cable, I am happy to say, has been successfully laid. The telegram, announcing this, arrived scarcely twenty-four hours before that intimating the event I have just mentioned. It is not improbable that the fever may have been increased by the excitement attending this. Since then, we are informed that a further section of the cable has been laid. This nearly completes the line between Guadal or Guadur, and Cape Mussendom. The Tweed has arrived here, and will join the expedition as soon as the stores are removed, and the cable machinery fitted up, work which is now being rapidly proceeded with. Of the Assaye and Amber Witch we have heard nothing; every day we look for their arrival. The Tweed brought us Mr. H. amongst others, whom the voyage appears to have suited exceedingly; also Mr. M., who appears well in health. P.S.—The Assaye has just arrived, so that, excepting the Amber Witch and Cospatrick, the whole of the ships are here."

A COMPANY has been formed for effectively carrying out and extending Bonelli's Electric Telegraph. The capital is to be £250,000, of which £25,000 forms the original capital of the company. Under the present arrangement there will be a further issue of £225,000, in 22,500 shares of £10 each, the deposit to be £1 on application, and £1 on allotment. A line is already established between Manchester and Liverpool, the working of which is stated to have exhibited practically and commercially the great excellence of Bonelli's system, and the directors, whose names and position are recognised, appear determined to give it full scope. Arrangements have, therefore, been made to acquire the entire patent-right for the United Kingdom, as well as to meet all the remaining expenditure necessary to establish operations on the proposed enlarged footing. It is intended to reduce the tariff to a uniform rate of sixpence per ordinary message of twenty words, while full rapidity, correctness, and punctuality will be attained. The typo-electrical instrument possesses a variety of advantages, among the foremost of which may be enumerated the printing of each message in the very act of transmission, and the celerity with which any extent of communications may be forwarded. Certainly the experiments made at the office show the effective nature of the working, and the valuable nature of the invention now it is to be brought into active use. Almost every department of business or profession that has anything to do with telegraphy will, it is asserted, benefit by the change; and, therefore, under the circumstances, the extension of the principle deserves to be supported.

THE PROSPECTUS of Silver's India-rubber Works and Telegraph Cable Company (Limited), has been issued, and the undertaking appears to be placed on a very safe foundation. The property is well known, and the direction comprises names that will be readily recognised. The capital is to be £500,000 in 10,000 shares of £50 each, of which 5000 will only now be issued. £2 per share is to be paid on application and £3 per share on allotment, of which a considerable proportion have already been subscribed for. There seems to be no doubt but that the business of the works at Silvertown has rapidly expanded, and that the operations carried on may be conducted with considerable profit, while the locality in which they are situated is favourable for the home and foreign trade. An important feature in the arrangement is that Messrs. Silver and Co. will still remain identified with the operations, and that their experience, skill, and influence will be used for the benefit of the company. Their confidence in its perfect success will, it is believed, be appreciated when it is stated that out of the amount to be paid for machinery and plant, stock, and book debts—say £100,000—they are willing to receive one half in shares and the remaining half in cash and debentures bearing interest at 5 per cent. For the freehold land and works, which are to be valued, they will also receive the larger portion in similar debenture.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine mixed, first and second qualities	2/2 to 2/6	per lb.
Good re-boiled	1/7 to 1/10	"

INDIA RUBBER.

Para, first quality	1/10 to 1/11	"
second "	1/7 to 1/8	"
third Negro-head	1/2 to 1/3	"
Java and Penang	1/4 to 1/6	"

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph	100	104 to 107	—
100	Submarine Telegraph, scrip.	all	48 to 53 x d	—
all	Do. registered	all	⅜ to ½ x d	—
5	United Kingdom Telegraph	3	½ dis. to par	—
10	Mediterranean Extension Tel.	all	3 to 4	—
5	London District Telegraph Co.	all	1½ to 2	—

TO CORRESPONDENTS.

*** The *Telegraphic Journal* will be published on Thursday next week.

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY'S DRAMATIC CLUB.—Account of performance unavoidably deferred until next week.

OLD DOUBLE NEEDLE AND MORSE CLERK.—Your communication arrived too late for insertion this week.

The *Telegraphic Journal* can be had of Messrs. SMITH & CO., Strand; Messrs. DAWSON & CO., Cannon-street, E.C.; Messrs. KENT & CO., Paternoster-row, London. Messrs. HEYWOOD & CO., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Single Advertisements from the country must be accompanied with stamps in payment.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)	0	3	0

THE TELEGRAPHIC JOURNAL.

VOL. I. No. 13.—MARCH 26, 1864.

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THE ATLANTIC TELEGRAPH.

THE great project which has now for many years engaged the attention of scientific and commercial men appears to rapidly approach realization. As to the practicability of deep sea telegraphy there exists happily no difference of opinion among our leading engineers and electricians. The valuable and important improvements which have of late been effected in the preparation and manufacture of insulating materials, and in the application of external strength, combined with enlarged experience, cannot fail to render future operations in deep sea telegraphy eminently successful and very profitable. When we contemplate the magnitude of the present undertaking, the vast interests which it is sought to strengthen and consolidate, it is impossible to exaggerate the importance of establishing telegraphic communication between the English and American shores. The incalculable advantages already derived socially, commercially, and politically by the extension of submarine telegraph lines become daily and hourly more appreciated, and render any temporary interruption in their working more keenly felt and deplored. In the effort now about to be made to submerge an Atlantic cable, the Company has sought the opinion and advice of men of the highest scientific attainments and practical experience, and who have been engaged in making numerous experiments, with the view of ascertaining the best form of cable, both as to its transmitting capacity and strength, the great object to be attained in the latter case being a minimum of extension and the maximum of breaking weight during the process of laying the cable. The Scientific Committee, out of the seventeen specimens received, have selected a cable designed by Messrs. Glass, Elliot, & Co., an engraving and comparative description of which will be found on the next page. The Committee, which consisted of the following distinguished *savans*—Capt. Galton, F.R.S.; W. Fairbairn, F.R.S.; W. Thomson, F.R.S.; Charles Wheatstone, F.R.S.; and J. Whitworth, F.R.S., state in their report that, with a view to determine the most eligible cable for submersion across the Atlantic, they had considered and discussed the results of numerous experiments that had been made upon the samples of cable supplied to the Company in answer to their advertisement, and upon improved specimens prepared subsequently by Messrs. Glass, Elliot, & Co., and that they considered the cable prepared by that firm to be the one most calculated to ensure success in the present state of our experimental knowledge respecting deep sea cables; and they accordingly recommended the Directors to adopt that cable. They further recommend that the following precautions be adopted during the manufacture by the Gutta Percha Company and by Messrs. Glass, Elliot, & Co. respectively, namely, that the conductivity of the copper strand be determined by the specification at a high standard, to be found by the electrical advisers of the Company, but not at less than 85 per cent.; that the electrical perfection of the core be determined by the unit system of measurement, and that the standard of the cable should certainly not be below that of the best cable hitherto made; that the core of the cable be tested under hydraulic pressure, and at the highest pressure attainable in Reid's tanks, now at the Gutta Percha Company's Works; that after submission to this pressure the core be carefully examined, and before it be transferred to Messrs. Glass, Elliot, & Co., it be required to pass the full electrical test under water; that all the tests of the core be made in water of a temperature of 70° Fahr., and after twenty-four hours submersion therein; that the Company, as well as Glass, Elliot, & Co., employ proper persons at the Gutta Percha Company's Works to check the electrical tests, and it is desirable that they should arrive at their results by a different process to that employed by the Gutta Percha Company; that the completed cable be continuously tested under water at such temperature as the electrical advisers of the Company decide on from time to time, and that the Company check the tests; that the joints be tested separately, and that no joint be passed which showed a leakage twice as great as that of a corresponding length of the core; that careful and frequent mechanical tests be made upon the iron wire and hemp, and that the Company as well as the contractors keep properly paid and respectable persons on the wire drawers' premises, as well as at Messrs. Glass, Elliot, & Co.'s Works, to check the strength and elongation of these materials.

The very efficient and stringent precautionary measures, carried out in their integrity, must result in the construction of a cable of the most perfect description in every respect. The advantage of such tests, carefully conducted and recorded, will prove at all times most valuable in the electrical management of the cable when submerged and in actual operation.

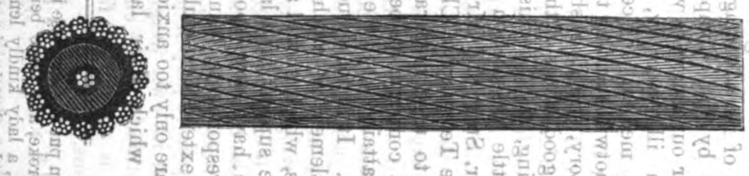
The experience derived in the submersion of the Toulon and Algiers deep sea cable has to a considerable extent influenced the decision of the Committee and the designers in the selection of the form of the new cable. No difficulty was experienced in paying out the above mentioned cable, and the electrical tests showed that its submersion was effected without in the least affecting injuriously its insulation. The form of cable adopted is thus described:—The conductor will consist of a copper strand of seven wires (six laid round one), each wire gauging ·048 or number 18 of the Birmingham wire gauge, and weighing 300 lbs. per nautical mile, embedded for solidity in the composition known as "Chatterton's Compound." The insulator is to consist of gutta percha, four layers of which are to be laid alternately with four thin layers of the above-named compound, making the diameter of the core of ·464 inches, and a circumference of 1·392 inches. The weight of the entire insulator is to be 400 lbs. per nautical mile. The external protection is to be in two parts; first, the core surrounded with a padding of soft jute yarn, saturated with a preservative mixture; next to this padding is to be the protective covering, to consist of ten solid wires of the gauge ·095 drawn from homogeneous iron, the same as now used by Whitworth in the manufacture of his celebrated guns, each wire surrounded separately with five strands of Manilla yarn, the whole of the ten strands thus formed of the hemp and wire to be laid spirally round the padded core. The weight of the cable in air will be 35 cwt. 3 qrs. per nautical mile; the weight in water will be 14 cwt. per nautical mile; the breaking strain will be 7 tons 15 cwt., or equal to eleven times its weight, per nautical mile in water; that is to say, if suspended perpendicularly from the stern of the vessel, it would bear its own weight in eleven miles depth of water. The deepest water to be encountered between Ireland and Newfoundland is about 2400 fathoms, and one mile being equal to 1014 fathoms, therefore—

$$1014 \times 11 = \frac{11{\cdot}154}{2400} = 4{\cdot}64$$

the cable having thus a strength equal to 4·64 times of its own vertical weight in the deepest water.

Perhaps not the least important feature in connection with the Atlantic Telegraph Company is the proposed employment of the Great Eastern, with its ample accommodation, in laying down the cable. The adaptability of the great ship for the conveyance and submersion of deep-sea telegraphic cables has long been recognised by nautical men; one great advantage being that the whole cable can be conveniently stowed in water tanks between her ample decks, and we can only reiterate our firm opinion as to the ultimate success of deep-sea telegraphy.

To enable our readers to compare the cable submerged between Ireland and Newfoundland by the Atlantic Telegraph Company in 1858, and the cable now being manufactured for the same Company by Messrs. Glass, Elliot, & Co., we insert a drawing and section of each cable exact as to size and detail:—



OLD ATLANTIC CABLE, 1858.

CONDUCTOR—A copper strand, consisting of 7 wires (6 laid round one), and weighing 107 lbs. per nautical mile.

INSULATOR—Gutta-percha laid on in three coverings, and weighing 261 lbs. per knot.

EXTERNAL PROTECTION—18 strands of charcoal iron wire, each strand composed of 7 wires (6 laid round one), laid spirally round the core, which latter was previously padded with a serving of hemp saturated with a tar mixture. The separate wires were each 22½ gauge, the strand complete was No. 14 gauge.

WEIGHT IN AIR—20 cwt. per nautical mile.

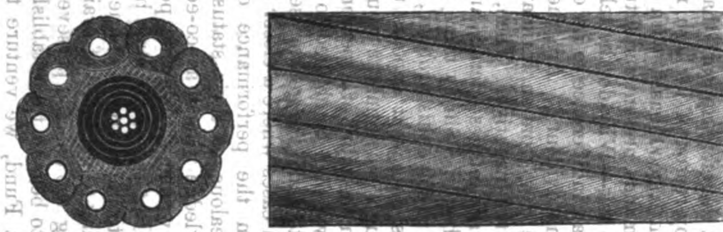
WEIGHT IN WATER—13·4 cwt. per nautical mile, or equal to 4·85 times its weight in water per knot—that is to say, it would bear its own weight in a little less than 5 miles depth of water.

BREAKING STRAIN—3 tons 5 cwt.

DEEPEST WATER TO BE ENCOUNTERED—2,400 fathoms, or less than 2½ nautical miles in depth.

THE CONTRACT STRAIN was equal to 4·85 times its weight per nautical mile in water.

ONE KNOT, being in fathoms $=1{,}014\times 4=\frac{49170}{2400}=2\cdot05$ times the strength requisite for the deepest water.



NEW ATLANTIC CABLE, 1864.

CONDUCTOR—Copper strand, consisting of 7 wires (6 laid round one), and weighing 300 lbs. per nautical mile, embedded for solidity in Chatterton's compound. Gauge of single wire ·048 = ordinary 18 gauge. Gauge of strand ·144 = ordinary No. 10 gauge.

INSULATION—Gutta-percha, 4 layers of which are laid on alternately with 4 thin layers of Chatterton's compound. The weight of the entire insulation, 400 lbs. per nautical mile. Diameter of core, ·464; circumference of core, 1·392.

EXTERNAL PROTECTION—10 solid wires of the gauge ·095 (No. 13 gauge), drawn from Webster & Horsfall's homogeneous iron, each wire surrounded separately with 5 strands of Manilla yarn saturated with a preservative compound, and the whole laid spirally around the core, which latter is padded with ordinary hemp saturated with preservative mixture.

WEIGHT IN AIR—35 cwt. 3 qrs. per nautical mile.

WEIGHT IN WATER—14 cwt. per nautical mile, or equal to 11 times its weight in water per knot—that is to say, it will bear its own weight in 11 miles depth of water.

BREAKING STRAIN—7 tons 15 cwt.

DEEPEST WATER TO BE ENCOUNTERED—2,400 fathoms, or less than 2½ nautical miles in depth.

THE CONTRACT STRAIN is equal to 11 times its weight per nautical mile in water.

ONE KNOT, being in fathoms $=1{,}014\times 11=\frac{11154}{2400}=4\cdot64$ times the strength requisite for the deepest water.

TELEGRAPH CLERKS' PROVIDENT FUND.

WHEN friends get into controversy, one of the greatest drawbacks to a solution of the question in dispute is the hesitation manifested by the disputants in the honest and full expression of their sentiments; this is especially the case in the discussion of social matters on which there simply exists a diversity of opinion. It has been remarked that the use of language is to enable man to disguise his thoughts, and we fear that several of our correspondents, in their communications on the subject of the Telegraph Clerks' Provident Fund, have urged every objection to the institution but those which actually determine their conduct in relation thereto. Like all special provident or insurance organisations, this Fund has a particular class of lives to insure, and the managing committee appear to have acted with wisdom in adopting the recommendations of an eminent actuary, and fixing the scale of premiums in excess of the general rate, thereby ensuring the stability of the institution, and guaranteeing to the member, as far as practicable, the benefits for which he subscribes. It happens too frequently that the projectors of benefit clubs fail to exercise necessary caution, and by offering inducements to all classes of lives, and transacting business at too low a rate of payment, jeopardise the character of the institution at the outset, and eventually create distrust in the minds of members, who, after having paid their subscriptions for many years, are not unfrequently deprived of the benefits on which they had depended by the collapse of the society. The evil does not end here, for persons once subjected to these losses, distrust their fellows, lose faith in all righteous principles, and relapse into habits of improvidence and indifference. To prevent evils of this nature a prudentist scale of premiums has been adopted by the Telegraph Clerks' Provident Fund, which is considered excessive, and has given rise to no small degree of dissatisfaction amongst the class for whose especial advantage the Fund was established. It has been urged that the conditions to be complied with by intending members are far too exacting, and that the restrictions imposed upon free members would debar them from manly exercise and sports of the field, except at their peril. With respect to the first of these objections, we have reason to believe that in the rules of nearly all respectable institutions, the managing committee reserve to themselves the privilege of demanding proof of age, &c., by the production of necessary certificates, where any doubt exists as to the representations of applicants for admission; and we are assured that in the Telegraph Clerks' Provident Fund no demands for certificates are ever made except in cases of apparent misrepresentation. The other point at issue was very easily explained by Mr. George Sheward, at the annual meeting of the Fund held on the 8th instant. Rule 9 appears to exclude all members from receiving sick pay whose illness is caused by "having been engaged in any games or sports," &c., but when it was shown that the word "unlawful" had, by some unhappy accident, been omitted before the word "games" in the preceding sentence, it at once became apparent that nothing but due caution had been exercised in framing the laws.

In all class or local benefit societies it is necessary to provide against extraordinary risks, for in their establishment we proceed in violation of the laws of average (on which all calculations of premiums should be based) to effect a condition of fraternal union—ignoring general principles, adopting a conservatism, and seeking isolation. A question at once arises—Is it more conducive to the interests of any class to associate for the purpose of mutual protection and advantage, or for each profession, trade, or guild to sink its individuality in the community? Our large general insurance companies, such as the "Royal," can with safety grant policies on far more reasonable terms to the insurer than minor associations; because the magnitude of their transactions will admit of greater speculation, and because there are many sources of revenue tending to counterbalance the great risks they hold (such as lapsed policies, &c.), which do not exist in the special institutions to which we have referred. It therefore appears that the Telegraph Clerks' Provident Fund, by reason of its high rate of subscription, has been founded upon a good basis, with every prospect of being able to meet all demands, present and future, upon its exchequer; and we are led to ask—Why do the telegraph clerks generally manifest so great an indifference to its claims? Is it that as a class they are improvident? Are they regardless of social obligations? We can, from an intimate acquaintance, answer these queries in the negative. Then, why do they not avail themselves of the advantages offered, and unite together in the bonds of brotherhood? Surely there is need of union. We have endeavoured to solve this problem, and will give the result of a few inquiries into what appears to us a matter of great importance, although our remarks would create an unfavourable impression on the mind of a person less disinterested than the one to whom we shall be obliged to refer.

Few men care to make the gentler sex acquainted with their troubles, unless in cases where a closer interest exists than that which arises from the performance of official duty. Men are excessively jealous of their status in society, and, while willing to acknowledge woman as co-equal, they still entertain convictions as to woman's place and power which they seldom care to express. But the truth must be spoken when its suppression is found to impair the usefulness of a good institution; and, while according a just meed of praise for valuable services, and acknowledging the energy, perseverance, and singleness of purpose brought to bear in the establishment of the Telegraph Clerks' Provident Fund, we venture to affirm that were the truly benevolent lady secretary to retire from the position which she has certainly filled with honour to herself and credit to the Fund, and make room for one of the sterner sex, then the accession of members would not only strengthen the society, but give Miss Oppenheim the satisfaction to know that the institution which she had inaugurated had become a blessing to thousands instead of its advantages being limited to a few persons employed by one Company. Another matter has been brought under our notice, to which we shall briefly advert. Englishmen, when ill especially, are very sensitive; and, although the best medical advice may be procurable from foreign lands, and notwithstanding that continental chemists may excel in the laboratory, still Englishmen have always manifested a partiality for the good offices of their own countrymen in times of pain and suffering, and for this reason we are inclined to think that some little indiscretion has been manifested in the appointments of Dr. Sutro and Mr. Baumgatten on the acting medical staff of the Telegraphic Clerks' Provident Fund. We have not a word to urge disparaging the abilities of these gentlemen; on the contrary, we believe that their position in society has been attained by the exercise of talent in their several professions. It is not a question involving the reputation of these gentlemen, so much as the policy of violating national prejudices, which should always receive consideration in cases where the support of a large class is sought for any organisation. We have now spoken out the sentiments of several of our correspondents, being persuaded that those who are now seeking to extend the usefulness of the Telegraph Clerks' Provident Fund are only too anxious to learn the cause of the indifference with which their labours have been hitherto received.

CRINOLINE has been put to a new use in Australia. At Wagga Wagga the telegraph wire broke, and there being no other suitable material at hand for repairing it, a lady kindly lent her crinoline, which, being dissected and used to tie the electric wire together, enabled the operators to use the line.

ELECTRICAL DISCOVERIES.

II.

Dr. Desaguliers commenced his experiments in 1739. He introduced the term *conductor*, to that body to which the excited tube conveys its electricity. He called bodies, in which electricity may be excited by rubbing or heating, *electric per se;* and *non-electric* when they receive electricity, and lose it at once upon the approach of another non-electric. In the year 1742, several Germans engaged in this subject. Mr. Boze, a professor at Wittemberg, revives the use of Hauksbee's globe, instead of using Grey's glass tube, and added to it a *prime conductor.* Mr. Winckler substituted a cushion instead of the hand, which had before been employed to excite the globe. Mr. P. Gordon, a Benedictine monk, and professor of philosophy at Erford, was the first who used a *cylinder* instead of a globe. With his electrical machine he conveyed the fluid through wires 200 ells in length, and killed small birds. Dr. Ludolf, of Berlin, in the year 1744, kindled by electricity the *etherial spirit* of Frobenius, by the excited glass tube; the spark proceeding from an iron conductor. Mr. Boze fired gunpowder by electricity. Mr. Gordon contrived the electrical star. Mr. Winckler contrived a wheel to move by the agency of the same fluid. Mr. Boze conveyed electricity from one man to another by a jet of water, when both were placed upon cakes of resin, six paces apart. Mr. Gordon fired spirits by a jet of water; and the Germans invented the electrical bells. Mr. Gralath fired the smoke of a candle just blown out, and lighted it again; and Ludolf the younger demonstrated that the luminous barometer was made perfectly electrical by the motion of the quicksilver.

Mr. Collinson, in 1745, sent to the Library Company of Philadelphia an account of these experiments, together with a tube, and directions how to use it. Franklin, with some of his friends, immediately engaged in a course of experiments, the results of which are well known. He was enabled to make a number of important discoveries, and to propose theories to account for various phenomena, which have been universally adopted, and which bid fair to endure for ages.

In the year 1745, such was the attention given to the subject of electricity, that experiments upon it were publicly advertised and exhibited for money in Germany and Holland. Dr. Miles, of England, in the same year fired phosphorus by the application of the excited tube itself, without the intervention of a conductor. It was at this period that Dr. Watson's attention was given to this subject. He fired air, made inflammable by a chemical process, and discharged a musket by the electric fluid. He made many experiments, some of which will be described as we proceed.

The year 1745 was made famous by the discovery of the *Leyden Phial* by Mr. Cuneus, a native of Leyden. It appears also to have been discovered by Mr. Von Kleist, dean of the Cathedral in Camin, about the same time. By this discovery, electricity could be accumulated and severe shocks given. Mr. Gralath, in 1746, gave a shock to twenty persons at once, and at a considerable distance from the machine. He constructed the electrical battery by charging several phials at once. Mr. Winckler, and also M. Monnier, in France, transmitted the electric fluid through several feet of water, as a part of the circuit. M. Nollet, in France, killed birds and fishes, by the discharge of the Leyden jars. Improvements were made by Dr. Watson, and others, in the Leyden phial, by coating the inside and the outside of it with tinfoil. Abbe Nollet gave a shock to 180 of the guards, in the king's presence; and at the grand convent of the Carthusians in Paris, the whole community formed a line of 3,600 feet in length, by means of wires between them. The whole company, upon the discharge of the phial, gave a sudden spring at the same instant. The French philosophers tried the same experiment through a circuit of persons, holding wires between them, two and a-half miles in length. In another experiment, the water of the basin in the Tuileries was made a part of the circuit.

M. Monnier the younger, to discover the velocity of electricity, discharged the Leyden phial through an iron wire 4000 feet in length and another 1319 feet, but could not discover the time required for its passage. Dr. Franklin communicated his observations in a series of letters to his friend Collinson, the first of which is dated March 28, 1747. In this he shows the power of points in drawing and throwing off the electrical matter. He also made the grand discovery of a *plus* and *minus*, or of a *positive* and *negative* state of electricity. Shortly after, Franklin, from his principles of plus and minus state, explained, in a satisfactory manner, the phenomena of the Leyden phial. Dr. Watson and others in July 18, 1747, conveyed the electric fluid across the Thames at Westminster Bridge; the width of the river making a part of the circuit. On the 24th of July, he tried the experiment of forcing the electric fluid to make a circuit with the bend of the river, at the New River at Stoke Newington. He supposed that the electric fluid would follow the river alone, through its circuitous windings, and return by the wire. He suspected from the result of this experiment, that the ground also conducted the fluid. On the 28th, he proved the fact by supporting a wire 150 feet in length upon baked sticks, using the ground as half of the circuit. On the 5th of August he tried another experiment of making the *dry* ground a part of the circuit for a mile in extent, and found it to conduct equally as well as water. The last experiment was tried at Shooter's Hill, on the 14th of August, of the same year. But one shower of rain had fallen for the five preceding weeks. The wires, two miles in length, were supported upon baked sticks, and the dry ground was used for the return, two miles of the circuit. They found the transmission of the electric fluid to be instantaneous. Mr. Canton, in England, and Beccaria, in Italy, acquired distinguished reputation for their electrical researches. They both discovered, independently of one another, that air was capable of receiving electricity by communication, and of retaining it when received. Mr. Canton also, towards the latter end of the year 1753, pursued a series of experiments which prove that the appearance of positive and negative electricity which had hitherto been deemed essential and unchangeable properties of different substances—as *e.g.* of glass and sealing wax—depend upon the surface of the electrics and that of the rubber. This hypothesis, verified by numerous and incontestible experiments, occasioned a controversy between Mr. Canton and Mr. Delaval, who still maintained that these different powers depended entirely upon the substances themselves.

The theory of two electric fluids always co-existent and counteracting each other, though not absolutely independent, was maintained by a course of experiments of silk stockings of different colours, communicated to the Royal Society by Mr. Symmer, in the year 1759, which were further pursued by M. Cigna, of Turin, who published an account of them in the Memoirs of the Academy at Turin in 1765.

REID'S PRESSURE TANKS FOR TESTING SUBMARINE CABLES.

The following is a description of Mr. Reid's patent machinery for testing the cores of submarine cables under pressure, referred to in our columns last and the present week. Mr. Reid had, some years ago, employed at different times several modes of testing telegraph wires for submarine purposes, such as immersing them in the sea at different depths, &c.; the plan now described was found to be a great improvement over that employed by the Gutta-Percha Company in having the wires tested in the canal, with seldom more than twelve inches of water over them.

The plan of testing in the sea, however good, has some disadvantages, such as stormy weather, the danger of having the wire injured on board ship, or in the transit to and fro, &c. Mr. Reid has, therefore, devised and adopted the following plan, which, for simplicity for giving a fair and impartial test of wires to any extent required, seems to provide for all contingencies that may arise in making telegraph cables effective:—

The inventor takes a strong iron vessel capable of containing five miles or more of core; it is made air and water-tight, and is filled with a number of air-tight stuffing-boxes for the purpose of passing the ends of the wire out of the cylinder and connecting them with a galvanometer. The vessel is also filled with gun-metal valves at top and bottom for the purpose of exhaustion, and for filling and discharging the water from the cylinder. The vessel weighs, in round numbers, about seven tons. To explain the working fully, the vessel or cylinder is filled from the top with as much wire as it will contain, bringing the ends of the several coils or drums through the stuffing-boxes already described; the cover is then put on the top of the cylinder and bolted down, having a ring of india-rubber for a joint. The air-pump, which is worked by steam power, is then applied, and a vacuum is formed by exhausting all the air contained in the cylinder and that of the core. Hitherto gutta-percha, with but one exception—a length of twenty miles manufactured by Messrs. Wells & Hall for the India Government—has only been

employed, and it is found that in the process of manufacture a considerable quantity of air has been mixed up with it, forming what is called air bubbles, and sometimes to be in places porous and spongy; in all such places the cavities which are filled with air have nearly reached the conductor, and in many cases must in time have proved fatal to the cable. To remedy this defect, the object of the air-pump is to remove all the minute particles of air. When the vacuum is considered perfect, as shown on the vacuum gauge, the exhaustion tube is closed, and the valve opened for the admission of water, which at once fills the cylinder, and occupies the spaces in the gutta-percha formerly occupied by the air. The hydraulic pump is now brought into action, and exerts a pressure equal to 600 or more upon the square inch, and after this pressure has remained for ten or fifteen minutes the indication on the galvanometer is again recorded, and if the needle remains quiescent it may be considered that the cable is safe for a depth of 250 fathoms; the pressure is still continued till it equals a column of water whose height is equal to the depth of the sea where the cable is to be laid, adding a sufficient margin to the pressure to make it perfectly safe, on the same principle as testing a beam or girder that has to carry a given weight, the pressure must exceed this weight or its safety becomes endangered. If we suppose a cable destined for the Atlantic, and the depth to be 2,000 fathoms, equal to 12,000 feet, the pressure applied in this case would be 5,295 lbs. on the square inch, equal to 2 tons 7 cwt. 1 qr. 3 lbs. When this pressure has remained on for fifteen minutes, again note the galvanometer, and if still quiescent the cable is sound, and may be safely immersed to the required depth. When the wire is removed from the cylinder it must be carefully wound off from one drum on another, passing through the hands of a careful operator, who will find a slight indentation on the surface where the pressure has acted on a crevice containing air. A thin, sharp knife must be passed under this indentation, and reach the bottom; if only slight it may be tooled up and restored; if it is a serious flaw it must be cut out, and the cable proceeded with. The further advantage of this process of testing is that the flaws and defects are all discovered at an early stage of the cable's progress, and before the expensive process of sheathing the cable with steel or iron wires has commenced, and the detection becomes more difficult. The engineer has now the satisfaction of knowing that he has a perfect core, and when laid in the ocean's depths it will not be subjected to any more pressure than it has already been subjected to, and that if carefully laid, and free from mechanical injury, the cable will work satisfactorily, and fulfil all the conditions that are anticipated from it. The great and crying evil with all deep-sea telegraphs hitherto made was the careless and hurried manner in which they were manufactured, and without a proper amount of inspection and supervision. The cable constructed for her Majesty's Government, and laid between Malta and Alexandria—the cable laid between Toulon and Algiers for the French Government—the cable which is now being laid for the Indian Government in the Persian Gulf—have all been subjected to pressure in the above tanks; and the proposed new Atlantic cable is, we believe, to be thoroughly tested in a similar manner.

THE INDIAN TELEGRAPH CABLE.

ON the Mekran coast, about 250 miles west of Kurrachee, the peninsula of Ras Noo is joined to the mainland by a narrow sandy isthmus, on which is Gwadur, a wretched town of mat-and-mud-built houses, inhabited chiefly by Beloochees, but subject to the Imaum of Muscat, who is represented by an Arab governor and guard. To the north of Gwadur the soft friable sandstone, the prevailing formation along the coast, increases in height and irregularity, the mountain ridges taking every conceivable form of pinnacle and buttress until they appear like a series of vast ruined castles and cathedrals. To the west extends a circular bay, some nine or ten miles across, with a regular sandy bottom, admirably adapted for receiving a submarine cable, and here commences the first section of the Indian cable, the land line eastward to Kurrachee being already completed and the telegraph-office in full operation, to the great marvel of the natives as well as of the chiefs, who come down to Gwadur with their retainers as far from the interior as the neighbourhood of Herat.

On the evening of the 4th February all the steamers and cable-ships belonging to the section (which had met at the rendezvous some days previously, with a punctuality auguring well for the future success of the expedition), having landed the heavy shore cable, started westward for Mussendom. The Victoria had been previously stationed on the course, some miles out to sea, to mark the first point where the cable might have otherwise run some danger of being laid upon an unsuitable bottom. The Coromandel, with Colonel Stewart, R.E., on board, piloted the course; following her, the Zenobia towed the Kirkham, Sir Charles Bright and his staff laying and testing the cable from her at the rate of about five miles an hour.

At noon on the 5th, 75 miles were laid, and at half-past 10 on the morning of the following day, having finished the 187 miles on board the Kirkham, the squadron came to anchor in lat. 25 19 N., long. 59 9 E., off Ras Mundanny, a spit of low swampy land between Ras Tank and Ras Zegin.

On the afternoon of the 7th, having joined the end to the cable on board the Marian Moore, the ships started again, the Kirkham returning to Bombay in tow of the Semiramis. At 9.30 a.m. on the 8th the ships anchored off Ras Jask, at the entrance to the Gulf, 298 miles being laid, and waited until the evening, so as to make the Arabian coast on the following morning.

Shortly after midday on the 9th, 357 miles having been laid, the Marian Moore anchored near the landing-place at Malcolm's Inlet, a sandy inlet ten miles in length, surrounded by steep and sterile mountains, and about 15 miles from Cape Mussendom, which gives its name indefinitely to the adjacent land.

The shore end was landed on the 13th, the interim being occupied in erecting a short length of land line and fitting up tents and accommodation for the operators. On the 14th the Marian Moore, with Messrs. Laws, Webb, Alexander, Lambert, and other engineers and electricians assisting in the work, started for Bombay, in tow of the Zenobia, to prepare and bring up the Tweed and Assaye, which arrived there with an aggregate of 730 miles of the cable on the 6th and 13th of February respectively. So far nothing could have been more successful, the cable when laid being in very far higher electrical condition than any other line yet submerged, and having been laid without the smallest drawback or embarrassment, either mechanical or electrical.

If the other arrangements proceed with equal regularity, we may shortly look for the completion of the Anglo-Indian Telegraph, though it is probable that some little time may intervene between the completion of the cable in the Persian Gulf and the establishment of the land lines in Mesopotamia and Persia on such a footing as to admit of the lines being opened to the public for the regular carriage of messages.—*Times.*

ON MAGNETIC STORMS AND EARTH-CURRENTS.

By CHARLES V. WALKER, Esq., F.R.S., F.R.A.S.

I.

AN account of the extensive and interesting investigations and observations conducted by Mr. Walker, have been from time to time presented to the Royal Society, and are printed in its transactions. The information contained in these papers is exceedingly valuable, and will, we believe, be read advantageously by those engaged in telegraphic operations. The reports contain numerous tables and diagrams in illustration of the phenomena which at times have had considerable influence upon the working of the telegraphic lines of this and other countries.

The author first refers to the movements of telegraph needles, due to causes external to the apparatus itself, which were noticed very soon after the first electric telegraphs were erected. In illustration, he gives some extracts from his diary at various dates in the year 1847; and a copy of a General Order which he issued on the 25th of October in that year, calling upon the telegraph clerks under his charge in the south-eastern districts of England to take notes of these phenomena, and forward them to his office. The telegraph in use there then, as well as now, is Cooke and Wheatstone's needle instrument, having one or two vertical galvanometers.

He makes some extracts from his "Electric Telegraph Manipulation," published in 1850, showing that the impression expressed in the extracts from his diary, of a connection between auroral manifestations and the phenomena in question, was confirmed. And he refers back to the published account of "The daily Observations of Magnetometers at the Royal Observatory, Green-

wich, in the year 1847, and extracts from it the reports made of the behaviour of the magnetometers on the days cited, showing that they were very much disturbed.

The author describes the time in question as a period of great disturbance; so much so, that in the year 1848 he was constrained to adopt a device by means of which the telegraph communication might be carried on, notwithstanding the presence of these foreign influences in the wires. But his plans were hardly matured and in operation before the cause disappeared; the disturbances almost entirely ceased. The years 1847 and 1848 had been periods of great activity. The year 1849 was a period almost of inaction; and this continued, a circumstance which, although it caused at the time some surprise, tended to withdraw attention from the question.

A paper by Mr. W. H. Barlow is then referred to, which was read before the Royal Society on May 25, 1848, and subsequently published in the "Philosophical Transactions," and in which a very interesting set of observations are given, made at Derby in May, 1848, upon various lines of telegraph centreing in that city. The relative bearing of the terminal stations, and not the route of the wires, is at the basis of these observations; and it is considered that the wires conveyed a portion of a terrestrial current of electricity, which current appeared to travel between S. 28° W. and S. 75° W.

The author goes on to state that, after a comparatively long lull, with only here and there a sign of moderate activity, attention was again called to these earth-currents about the year 1856; and more definite instructions were issued for observations to be made, and returns sent in, which has led to a large accumulation of observations, commencing early in 1857. It is not his purpose to discuss the mass of observations, nor to extract from them the dates of great disturbance; for this would only go to show the general relation between earth-current, magnetic disturbance, and aurora, which is already well established.

The most notable period of disturbance that has occurred since electric telegraphs have been in existence, was from August 27th to September 6th, 1859. It was recognised in one or more of its modes of manifestation, not only in Europe and America, but in Australia. Notices of the phenomena, collected in all parts of the world, are given by Prof. Elias Loomis in the "American Journal of Science and Arts," and occupy ninety-three pages. Two articles in "Les Archives des Sciences Physiques," by Prof. De la Rive, are also referred to. Referring to the reports in question, it was evident to the author that those who, like himself, had electric telegraphs under their control, had, to a certain extent, failed in their duty. He had, it is true, collected many observations, but they had been neither discussed nor published; and M. De la Rive had to express his regret that the returns which reached him of this great storm gave him no clue as to the direction of the currents; and for lack of this information the conclusions to which he arrived admit of reconsideration. Mr. Walker, upon learning this, took the matter up more actively. The south-eastern district, where the observations were made, may be regarded as bounded N. by the Thames, E. and S. by the British Channel, and W. by the other southern counties of England. Kent, Surrey, Sussex, and Berkshire, are concerned in contributing to the observations. Eighteen pairs of terminal stations have been selected; the eighteen direct lines, drawn to connect each pair of stations, make different angles with the magnetic meridian. The view taken by the author is that a flood or stream of electricity, of indefinite width, is drifting across the country, and that portions of it appear as derived currents in the telegraph wires, entering by the earth connection at one terminus, and leaving by like means at the other. The derived current enters at the terminus nearest to the point of the horizon *from* which the main current flows, and leaves at that nearest the point *toward* which it flows.

A Table is then given of the eighteen pairs of stations, their names, the angle their joining line makes with the magnetic meridian, the direct distance from station to station, and the distance by the wire route.

The returns made of the August-September storm of 1859 are more meagre than usual, for reasons that are given; and the author explains, that on the very days when the clerks would be most valuable as observers, they are more occupied in their ordinary duties from the presence of the disturbances, which harass them in their work; and on this account he expresses himself the more indebted to those who have observed so well at such times, especially to Messrs. J. Dyke, D. Malpas, and T. Pulley.

An extract is next given from the last Report of the Astronomer-Royal to the Board of Visitors, stating that he cannot extract from the returns made by telegraph clerks an idea of the phases of earth-currents, to make them comparable with those of magnetic storms. Into these views Mr. Walker enters; and while pleading guilty to not having contributed from his district any observations to the Royal Observatory, he explains that it is because he had not heretofore had the opportunity of subjecting what he had collected to anything like a fair discussion. But he quite agrees with the Astronomer-Royal, in thinking that it may turn out to be desirable that observations of earth-currents should be made in a magnetic observatory, side by side with those of the magnetometers, on wires specially erected, which wires, as appears from the sequel, need not be of any great length; for the Margate-Ramsgate group, three miles in length, is found to be very active, and action has been found on a length of 972 yards.

Reports are then given of the behaviour of the needles during the August-September storm of 1859, followed by a Table containing a series of consecutive observations which the Ramsgate clerk made from August 29th to September 2nd, and which show the duration and changes of the currents, the *general* direction in which they were moving, and their comparative values; details which were wanting to M. de la Rive when he wrote on this storm.

The author adverts to the remarkable manner in which the change from a current in one direction to a current in another is brought about, by no drift of anything like a "circular storm," nor by any kind of axial rotation; and in contrast to the calm minutes in the midst of an active period, he cites cases of activity, which are common enough in periods otherwise calm. He shows also how the value of the derived current varies with the size of the wire.

Passing from this more general view, he describes the arrangement made for forming a more definite opinion of the value of the currents collected, and how he proposed to turn to better account the next storm-days, of which some good cases followed on August 8 to 12 inclusive, and on Sept. 7, 1860, which is the last storm-day that has occurred. On the days in question a good series of observations were made, the results of which are given in Tables which accompany the communication. These Tables are discussed, and the values of the currents of either kind are given in detail in degrees and in time; and the means are deduced. Before discussing the results, the author takes occasion to call attention to the very active habit of the Margate-Ramsgate line, and to the high value of the currents collected there, although, as before stated, its length is only three miles.

On discussing the Tables, it appears that 1 current in 20 had a duration of less than half a minute. The proportion of currents above and below 5 minutes duration was 1 to 2·32. Of those above 20 minutes and those between 5 minutes and 20 minutes, the proportion was as 1 to 3·6. The 1-minute currents are most in number; then, in order, the 2-min., 3-min., 4-min., ½-min., and 5-min. The observations, which embraced a period of 50 hours 42 minutes, show very nearly an equal duration of N. and S. currents, the difference being 21½ minutes in favour of the S. currents. The mean duration of N. currents was 9·51 min.; of S., 9·42 min. The proportion of currents exceeding 45° in value to those below 45°, was as 1 to 6·49. The 15° to 20° currents are most in number; then follow, in order, the 5° to 10°; then the 10° to 15°. The mean value of the N. currents was 28°·01; of the S., 26°·07.

Mr. Walker then refers to the opinion of M. De la Rive, that the S. currents are merely due to the secondary polarities acquired by the earth-plates, and shows that it is not in accordance with the facts here accumulated, for, from the results given, it would be hard to say that either the N. or the S. currents exceed the other in value; and no one thing could here be said of the N. currents, which might not with equal truth and equal force, be said of the S. currents.

The remarks thus far have reference to a solitary telegraph group, from which the *general* drift, but not the *special* direction of the earth-currents, is gathered. The action produced might be equally due to a current running in a direction many degrees to the right or many degrees to the left of the direct line joining the two stations. In illustration of this, a series of diagrams have been prepared, in the first of which the lines of direction (referred to the magnetic meridian) of all the telegraph groups are set off; in others, the lines alone on which observations were made at a given time, are laid down. In proportion as the two boundary lines in any case make a greater angle with each other, the absolute

direction of the current is more nearly determined. Cases are given and discussed, and the conclusions progressively arrived at, in order, as lines with a greater angle occur, to give the dimensions and position of the arc of the horizon within which the resultant line is situated. When observations are obtained from only one line, the resultant is known to be somewhere in one half of the horizon; but the place is not proximately defined. Frequent observations were made on a pair of lines making an angle with each other of 74°. This reduced the limit, within which the resultant was to be sought, to 106°. Other observations were made on a pair of lines making an angle of 138°, which reduced the limit to 42°. And finally, a table of observations is given, which were made upon a pair of lines making an angle of 149°, which reduces the arc within which the resultant is to be sought, to 31°; and this is the closest result that has yet come out from absolute observation. This arc is within the limits of each of the larger arcs that come out from the previous observations, and it extends from 46° to 77° E. of the magnetic north.

The currents in all the cases cited were not confined to the limiting lines, but were constantly found in one or more of the intermediate lines, and always in a direction consistent with the view taken. In the last case, where the arc is reduced to 31°, and in most of the observations tabulated, the current in the limiting lines was so strong that the author felt himself fully justified in concluding that if he had lines of telegraph beyond these limiting lines, he should have found currents: he has assumed 10° as not likely to be beyond the range; and this reduces the arc to 11°; and knowing from experience in which limiting line the current is apt to be more active, he has divided the arc of 11° into the proportion of 7° to 4°, and has set off a line, which may be taken to be a very close approximation to the direction in which the currents move. It falls 63° E. of magnetic N.; and by deducting from this 21½°, the value taken for magnetic declination, the direction of the earth-currents, referred to the astronomical meridian, is 41½° E. of N., or N.E. within 3½°. When the currents change in direction, it becomes S.W. within 3½°. The cases discussed go back as far as 1857; and there appears to have been the same general direction during that period. A N.W. and S.E. direction for the resultant is not known.

The author discusses, as well as he can from the few data before him, a few observations made in France and Switzerland. They are meagre in detail, but confirm the impression, which would naturally arise, that some such general direction will be found there. He also refers back to Mr. Barlow's paper, in which an arc of 47° was obtained, and within which the N.E. bearing was situated, being 30° from one limit of the arc, and 17° from the other; showing that from the year 1848, to the present time, no great change in azimuth has taken place.

A few remarks follow in explanation of certain specialities and anomalies in the behaviour of some of the lines in respect to their azimuths, and on the relative conductive power of the various geological strata concerned. And the author thinks it very probable that many of the currents observed some thirty years ago in the metalliferous veins in Cornwall, may have been veritable earth-currents, and may have been coincident with magnetic storms.

Having determined the proximate direction of earth currents, Mr. Walker referred to the magnetometers of an observatory merely as magnets, in order to discover whether the magnetic disturbances at a given time were in accordance with the known reaction of electric currents and magnets. The Astronomer-Royal, as well as General Sabine, furnished him with the photograms from Greenwich and Kew respectively, which he required for making the comparisons. He has selected some cases of earth-currents, and has set them out in curves, side by side with the Greenwich or Kew curves, and has found a sufficient amount of coincidence to confirm the conclusion that arises, and to encourage further enquiries. He has laid down the position which the declinometer and the horizontal-force magnetometer would tend merely as magnets to assume under the influence of currents moving in the assigned direction, and has given some extracts from the Greenwich observations in support of the views he takes.

The author has made no attempt to trace the origin of the currents in question. He simply takes them as he finds them, and endeavours to arrange them in some degree of order; and he touches very lightly upon terrestrial magnetism itself. He considers that, "although we are considerably in the dark as to the forms of force in operation to make up the *whole* of the causes concerned in magnetic disturbance, we are yet quite certain that the current form of force is at least in *part* concerned." And he adds, "We can collect this force and measure it, and deal with it independently. We can receive the results and record them photographically, as foreshadowed by the Astronomer-Royal, side by side with those of the magnetometers. And doubtless, should such combined results come at any future day under discussion, and more so, should they pass into the hands of General Sabine, a method would be devised of eliminating the value due to these known causes, that is, due to earth-currents absolutely collected, and thereby rendering the value thus corrected more manageable; and we might get one step nearer towards penetrating into the more recondite causes of the earth's magnetism and its variations." And this cannot be accomplished until Mr. Airy's suggestion, of including the earth-currents in the observations of a magnetic observatory, is realised.

MISCELLANEOUS EXPERIMENTS.

ON charging a portion of gutta percha covered copper wire, and then putting it to earth, found that, after a short period, a second or residuary charge remained in the wire. After more careful experiments, this residuary charge was found to manifest itself ten or twelve times—its amount being greater when some time was allowed to elapse after the previous contact with the earth. Concluded from this that the residuary resides in the inequalities of the gutta percha, and creeps gradually to the copper, where it is accumulated, if sufficient time be allowed for the purpose. Going further, it may be presumed that gutta percha is porous to a certain extent; and the residuary resides in those pores—or, in other words, in the structure of the material. [Such is the case with all other insulating materials.—ED. T. J.]

Eight miles were next charged negatively and eight miles positively (seventy-two cells). On connecting the respective eight miles together, produced neutrality. Then took off one mile from *one* group of eight, then connected the eight to the seven, and found a residuary charge of 8°; then took off another mile, and connected eight with six, and found a residuary of 16° 30′; then took off a third mile and so on, and obtained 24°, 32° 30′, 40°, 48° 30′, 59°, and 68°.

Experiments with a Peltier Electrometer.

One pole of sulphate battery, connected with the stem of instrument, the other pole being attached to earth-plate in successive increases of series, as under—with twelve cells, the deflection was 0°; twenty-four cells, 2° 30′; thirty-six cells, 5°; forty-eight cells, 7° 30′; sixty cells, 10° 30′; seventy-two cells, 12° 30′; 144 cells, 26° 30′.

Continued charge on Insulated Wires.

The charge was kept on for some weeks, but no change whatever took place in the insulating properties of the various materials, which consisted of pieces, five feet each in length, of the following dimensions, immersed in water:—1st. copper, 8·32 in diameter; gutta percha, 6·32 in thickness; 2nd. copper, 4·32 in diameter; gutta percha, 6·32 of an inch in thickness; 3rd. copper, 2·32 in diameter; gutta percha, 6·32 in thickness; 4th. copper, 2·32 in diameter; gutta percha, 3·32 in thickness; 5th. copper, 2·32 in diameter; gutta percha, 12·32 in thickness; 6th. copper, 1·32 in diameter; gutta percha, 1·32 in thickness; 7th. copper, 2·32 in diameter; gutta percha, 2·32 in thickness; 8th. copper, 2·32 in diameter; Ratcliffe's gutta percha, 6·32 in thickness; 9th. copper, 2·32 in diameter; Wray's compound, 6·32 in thickness; 10th. copper, 2·32 in diameter; Daft's vulcanized india rubber, 3·32 in thickness; 11th. Copper, 2·32 in diameter; Wells & Hall's india rubber, 2·32 in diameter, 2·32 in thickness; 12th. copper, 2·32 in diameter; Silver and Co.'s india rubber, 3·32 in thickness. The number of elements employed, 512. Muirhead's improved sulphate battery.

THE galvanic fluid affects all the senses. Nothing can be more disagreeable than the shock, which may even be fatal if the battery be very powerful. A bright flash of light is perceived with the eyes shut, when one of the wires touches the face and the other the hand. By touching the ear with one wire, and holding the other, strange noises are heard, and an acid taste is perceived when the positive wire is applied to the tip of the tongue, and the negative wire touches some other part of it. By reversing the poles, the taste becomes alkaline. It renders the pale light of the glow-worm more intense. Dead animals are roused by it as if they started again into life; and it may ultimately prove to be the cause of muscular action in the living.

THE INTERNATIONAL EXHIBITION, 1862.

(*Continued from page* 140.)

Digney Brothers, Paris, M. (France, 1,414), exhibit an automatic transmitter adapted to the usual Morse signals.

Messrs. Digney punch in a strip of paper long or short rectangular holes, corresponding to the dots and dashes required. The long and short holes are made with separate punches, placed side by side; thus all the dots are in one row, and all the dashes in another beside it. These punches are depressed by separate levers, which are so connected with pauls that the depression and rise of the dot lever moves a ratchet-wheel, connected with a drawing-roller, two teeth forward, whereas the dash lever moves the same wheel three teeth, and a space lever, which has no punch, moves the wheel one tooth forward. The paper is thus drawn forward one, two, or three times the length of the dot punch, according to the lever depressed.

When the paper has been thus prepared, it is placed in the transmitting apparatus, through which it is drawn by clockwork. In its passage it passes over a roller with two grooves, corresponding to the centres of the two lines of holes.

Two little bent rocking levers have pins on their ends which rest in these grooves when not covered by the paper. The other ends of the two rocking levers are used to make contact with two metal stops, against which they are pressed by light springs. The stops are both in connection with one pole of the battery, the other pole of which is in connection with the earth. The rocking levers are both in connection with the line. When plain paper is passing over the roller, the pins of both levers are lifted by the paper out of the grooves, and the other, or contact ends, are held back from the stops. The circuit is therefore interrupted; when a hole passes under either pin it falls through into the groove, and the other end of the lever comes in contact with the stop, completes the circuit, and sends a current through the line. The duration of this current obviously depends on the length of the hole and the speed at which the paper is drawn through. Messrs. Digney by this plan avoid the difficulty of making good contacts through the holes in the paper. These holes play a purely mechanical part, the contacts are made by dead pressure, and the play of the levers is considerably greater than the thickness of the paper.

So far this arrangement is a real improvement on some of the plans hitherto proposed. It has, however, various defects. The punches are very large, they require considerable power to work them, and would be far more fatiguing to the hand than the usual Morse key, or the little punching machine of Professor Wheatstone's arrangement. The feed or drawing motion for the paper in the punching instrument is bad, and gives very irregular spaces, as must be the case wherever drawing rollers are used. The paper always slips a little, and slips very unequally. A great deal of paper would also be used by this transmitter. The advantage claimed for it—that the common Morse alphabet can be retained—has little weight, since Professor Wheatstone's arrangement, free from all the defects just named, can with perfect ease be made to send the common dots and dashes instead of positive and negative dots. Finally, this key is said to transmit only about twenty-five words per minute, or not more than a good clerk will send by hand.

Siemens & Halske, Berlin, M. (Prussia, 1,413), exhibit an automatic magneto-electric transmitter, working by means of movable metal types, and intended for use with the usual Morse code and the polarized receiver.

Reverse currents are continually induced by the continuous revolution of coils, arranged between magnets as in the other magneto-electric instruments shown by this firm, and driven by a belt from a treadle. The admission of these currents into the line is determined by the type-stick or rod, in which the message has been previously set up in types. These types consist in alternate ridges and hollows, which, however, by no means correspond—in outward appearance at least—to the lines and intervals which are received at the other end of the line, as will presently be explained.

A little bent rocking lever rests with one end on the type, and when lifted up by a ridge makes a contact at its other end, which allows the induced currents to pass into the line, but which falls back and interrupts these currents whenever the ridge ceases. Thus one continuous ridge would allow a continual succession of equal reversals to enter the line, and would produce equally spaced dots on the Morse receiver. If a vacant space or hollow occurred in the ridge, it might produce a continuous line or a continuous space, according to whether the ridge ended just after a positive current had been sent, or after a negative current had been sent, and produced its effect on the polarized receiver. Thus it appears, that not only the *length* of the ridges and spaces forming the type, but the exact *position* of these ridges when passing under the contact lever, relatively to the position of the induction coils in their revolution is of the utmost importance, and that the very same type might send different signals, if differently placed, relatively to what may be called the angular position of those coils.

Messrs. Siemens move the type slide along under the contact lever by an endless screw in connection with the coils, and working into a rack on the type-stick. By that arrangement the rod or stick, which holds the type, always occupies a definite position relatively to the angular position of the coils—*i.e.*, when the induced currents are, say *nil*, there will always be one of a series of definite equally spaced points on the rod, beneath the end of the rocking lever. The next point to observe is that the types themselves always occupy a definite position in the stick. They are held by little projections on the types fitting into transverse grooves in the rods; each type is therefore independent of its neighbours, and so, whatever be the order of its ridges and spaces, they will always make and break contact at exactly the same points of revolution of the induction coil, independently of the position of the type relatively to other types. Each letter has a separate type. When a dot is required, a ridge is placed so as to admit one, say positive current, followed by one negative current, into the line; a ridge of twice the length gives two dots, and a ridge of three times the length three dots. A line will, on the contrary, be produced by a ridge of half the length of the dot ridge, admitting a positive current, but not the succeeding negative one. At the end of the line another short ridge must be placed, so as to admit one negative current to bring back the armature of the polarized receiver.

Wherever a space is required between words or letters, the ridge preceding must end immediately after admitting a negative current. No hollow is required on the type to separate successive dots and dashes; thus a single long ridge gives the letter S, or three dots; a short ridge, followed at intervals by two ridges of double the length, and then one short ridge, gives the letter O, or three dashes. The type admits first a positive current, but stops the negative; after a time it admits by the second ridge a negative current, followed at once by a positive current and an interruption. The third ridge plays the same part as the second; and lastly, the fourth short ridge admits a negative current, followed by an interruption. (It will be clearly perceived that exactly similar effects would be produced if everywhere in the foregoing description positive were written for negative, and *vice versâ*.)

This plan has many good points. The contacts are dead pressure contacts, and can be made with any required force, and consequently with any required rapidity, since every part is strongly made, and metal alone is dealt with. The magneto-electric currents are all of equal and very great intensity, being produced by a continuous motion, which is in this case attended with exactly the same benefit as in Professor Wheatstone's dial instruments, to be presently described. The type-sticks are easily filled in, and hooked one on to the other, so as to follow in unbroken succession for a message of any length. Lastly, the common Morse code is retained. The receiver used in connection with this instrument is a direct ink receiver, with the writing disc revolving in an ink trough, and has been already described.

Messrs. Siemens state that by this instrument they have transmitted messages at the rate of 80 words (or about 400 letters) per minute, through a circuit beginning in London, passing to Paris and back, then to Cromer and back, and finally through a long series of resistance coils. The total resistance of the circuit was equal to 2,550 miles of land line, and was composed of 800 miles of land wire, 50 miles of submarine cable, and 1,700 miles in the resistance coils.

It seems, however, probable that this experiment was inconclusive, as only one earth-plate is said to have been used at the station from which the signals were sent, and to which they returned. It is not certain that the currents ever passed in a legible condition through Cromer or Paris. It is well known that signals can apparently be sent even without a closed circuit, by connecting the battery and receiving instrument between two insulated wires long enough to act as Leyden jars of large capacity. The use of a single earth-plate will not entirely prevent this phenomenon when the earth connection has, as is always the case, a sensible resistance. The surprising number of words sent would entail a transmission at the rate of more than 2,400 reversals per minute, and it is most desirable that their apparently distinct reception should be proved

by further experiment, by which all uncertainty might be removed. M. Guillemin's experiments especially lead the writer to doubt the real transmission of 80 words per minute through the above immense circuit.

Whatever be the effect of the retardation, as proved by further experiment, it must be allowed that Messrs. Siemens' instrument possesses great merit to give the above speed, even through resistance coils.

T. Allan, M. (United Kingdom, 2,850), exhibits a series of instruments (of which his sparkless relay, already described, forms one) intended for the rapid and automatic transmission of messages. Mr. Allan prepares his messages on paper by a punching instrument, and then draws one end of the prepared strip between the rollers of his transmitter, which hereupon starts, and continues, without further intervention on the part of the clerk, to draw on the paper, and transmit the required sequence of currents along the line to the receiving relay and printing instrument, which at once starts, and continues to work without any intervention on the part of the clerk. The sending and receiving instruments are driven by electromotors with local batteries until a short time after the message comes to an end, when they stop, ready to recommence their functions, when the transmitter is started by the introduction of a fresh strip of paper.

Mr. Allan, like many others, uses paper punched mechanically to represent his message at the transmitting end; his alphabet, already described, is composed entirely of groups of dots, and by the depression of a single key for each letter, he punches at one blow the required group. These groups of holes are used in the transmitting instrument to determine the motion or rest of a toothed wheel which gears into these holes. On the axis of this wheel is another wheel acting as a contact maker for a local battery, which works a reciprocating electro-motive arrangement, winding up a barrel spring which drives the mechanism by a train of wheels. Moreover, each beat of the electromotor corresponding to each hole in the paper, sends a single current from a separate battery into the line. Alternately positive and negative currents are sent, one for each dot.

These reverse currents are received by the sparkless relay, and the two local circuits described in connection with that instrument work an electromotor similar to that of the transmitter, besides moving the style which prints the dot. This second electromotor winds up a barrel spring used by a train of wheels to drive the rollers drawing on the paper on which the received message is printed.

An ingenious contrivance (a loose tooth on a ratchet-wheel) is in each case employed to prevent these barrel springs from being overwound, or wound so far as to stop the electromotors. The cessation of the message both at the sending and receiving end allows the barrel spring to run down, owing to the stoppage of the electromotor, and finally breaks the local circuit so as to prevent needless consumption in the batteries. The transmitter is furnished with a key, by which the clerk can send signals by hand in the usual manner, if necessary. Great ingenuity is apparent in every part of these instruments, which can hardly be adequately described without the use of drawings. This system has a better title to the name "automatic" than any of the others, for the functions of the clerk are reduced to the first introduction of the prepared message into the instrument. There are no handles to turn, or treadles to work, or springs to wind up. It is doubtful whether the advantages to be derived from this automatic action are not more than counterbalanced by evils arising from the unavoidable complication. Mr. Allan, however, considers his apparatus less complicated than the usual Morse instruments.

(*To be continued.*)

Mr. Prescott, in his *History of the Electric Telegraph*, gives the following as the rapidity of transmission on the several instruments in use in 1860:—Cooke and Wheatstone's needle telegraph of Great Britain, 900 words per hour; Froment's dial telegraph of France, 1,200; Bréquet's dial telegraph, also French, 1,000; Siemens' dial telegraph, formerly used on the Prussian lines, 900; Bain's chemical, in use between London and Manchester, and formerly, to a considerable extent, in the United States, 1,500; the Morse telegraph, in use all over the world, 1,500; the House printing, used in the United States, to a limited extent, and in Cuba, 2,800; Hughes', and the combination instruments, 2,000. The last three systems are American inventions. Thus it will be seen that to our country is due the credit of inventing the most rapid and the most universally used telegraphic system.

RAILWAY SIGNALLING APPARATUS.

Mr. H. Allan sends us a description of a railway train signalling apparatus, which consists of a black board with a white and red flag painted on the surface on either side, such signals being understood by every one connected with a line of railway.

The pointer or flag staff consists of a very slim slip of ivory attached at right angles to the centre of a light permanent magnet, pivoted and oscillating between the poles of two electro-magnets, so that by changing the circuit, by depressing either key, the permanent magnet is attracted and repelled at the same moment, thus throwing over the pointer, which is retained in this position until the key reversing the circuit be touched. On the back of the dial, as a communicator, is placed a galvanometer, with a weighted needle suspended, oscillating between two bells or glasses, and which forms part of the circuit with the electric magnets, communication being made by a certain number of blows being given to either, by the key being depressed according to the signal blocked.

MR. WM. LADD'S NEW ELECTRO-MOTIVE ENGINE.

This exceedingly ingenious machine consists of four bar electro-magnets firmly secured to the corners of a stout iron plate, forming the base of the instrument. To the top of these is secured a circular brass plate, carrying the break, revolving armature, &c. The connections are so arranged with the break, that the magnetism is excited at the opposite corner alternately.

The armature is formed of eliptical plates of soft iron, from which peculiar form during each quarter of a revolution it approaches two of the electro-magnets. The instant the major axis is in a line with the magnet, the current is changed to the other two, and this is repeated four times in each revolution.

By means of a screw and wheel the power is communicated to a shaft. The whole machine occupies a space of six inches square by seven inches high, and when worked with a small battery it exerts a very considerable power.

CORRESPONDENCE.

FAULTS IN INSULATION.

To the Editor of the Telegraphic Journal.

Sir,—"K. H.'s" opinion is, I think, quite correct. It has always been practically found that the signals received at the station nearest a fault are the strongest, with the batteries and instruments used in this country. In my Handbook I have gone very fully into the "effects of faults in insulation," and have endeavoured to show the reason of the fact "K. H." inquirds about. See pp. 65 to 74.—Yours, &c.,

R. S. Culley.

TELEGRAPHIC FAC-SIMILES.

To the Editor of the Telegraphic Journal.

Sir,—In your journal of the 12th instant you give an account of experiments made in April, 1848, between London and Brighton, with Bakewell's copying telegraph. The inaccuracy of some of the statements being so palpable, I think it right to call your attention to them:—

1st. It is stated that the experiments were made in 1848. That could not be, as at the period in question no telegraph existed between London and Brighton.

2nd. Your correspondent states the rate of speed was about 150 letters per minute. I cannot understand how such a calculation could be made, when it took two whole days before a perfect message was received, and that one occupied nearly one hour in transmission, containing only a few words.

3rd. Your correspondent would lead the public to infer that the messages could be received either visible or invisible, at the option of the operator. Such was not the case, as the "chemical process" was at that time a part of the arrangement to render the message at all visible.

4th. The experiments stated by your correspondent to have taken place in 1848 were first attempted in April, 1851—just three years after the time stated by him.

As it is not fair that the public should be misled by such statements as your correspondent puts forward, I feel it my duty to call your attention to the above, and am,

One who took Part in the Experiments.

ORIGIN OF THE ELECTRIC TELEGRAPH.

To the Editor of the Telegraphic Journal.

Sir,—A few years ago the appended interesting inquiry appeared in a valuable and instructive weekly publication called *Notes and Queries*. I should feel greatly obliged if some of your readers north of the Tweed could furnish me, through the medium of your columns, with some particulars, or, it would be more satisfactory, with a copy of the important letter of "C. M." It is not with a view in any way to detract from the well-deserved credit accorded to Messrs. Cooke and Wheatstone, as the gentlemen to whose joint labours we are indebted for the practical realization of the electric telegraph, that I make the inquiry, but simply to ascertain as far as possible to whom we are indebted for first suggesting electricity as a means of communicating between distant parts.—Yours very truly,

Electrician.

"The Electric Telegraph.

"Powerful as this extraordinary agent has become, and incalculably useful as its operation is now found to be, it would appear that the principle of the electric telegraph and its *modus operandi*, almost identically as at present, were known and described upwards of a century ago. On the occasion of a late visit to Robert Baird, Esq., of Auchmeddan, at his residence, Cadder House, near Glasgow, my attention was called by that gentleman to a letter initiated 'C. M.,' dated Renfrew, Feb. 15, 1653, and published that year in the *Scots' Magazine*, vol. xv., p. 73, where the writer not only suggests electricity as a medium for conveying messages and signals, but details with singular minuteness the method of opening and maintaining lingual communication between remote points, a method which, with only few improvements, has now been so eminently successful. It is usual to attribute this wonderful discovery to the united labours of Mr. W. F. Cooke and Professor Wheatstone; but has any one acknowledged the contribution of 'C. M.,' and can any of the learned correspondents of *Notes and Queries* inform me who he was?

"Glasgow. "Inquirendo."

TELEGRAPHING WITHOUT A METALLIC CONDUCTOR.

To the Editor of the Telegraphic Journal.

Sir,—The following extract is given by a writer in the *Guardian* vol. 2, published in the year 1713, in describing Strada's narrative of an entertainment given before Pope Leo the Tenth and an audience of the greatest eminence, refers to the subject of a poem delivered by one of the great critics, which may doubtless interest your readers, as it shows that telegraphing without a metallic conductor is no new invention, as it must have been known in those days. The insertion in your next publication will oblige,

William U. Corton.

Magnetic Office, Southport, March 21, 1864.

[Extract.]

"Strada, in the person of Lucretius, gives an account of a chimerical correspondence between two friends, by the help of a certain load-stone, which had such a virtue in it, that if it touched two several needles, when one of the needles so touched began to move, the other, though at never so great a distance, moved at the same time and in the same manner. He tells us that two friends, being each of them possessed of one of these needles, made a kind of dial-plate, inscribing it with the four-and-twenty letters, in the same manner as the hours of the day are marked upon the ordinary dial-plate. Upon their separating from one another into distant countries, they agreed to withdraw themselves, punctually, into their closets, at a certain hour of the day, and to converse with one another by means of this their invention. Accordingly, when they were some hundred miles asunder, each of them shut himself up in his closet at the time appointed, and immediately cast his eye upon the dial-plate. If he had a mind to write anything to his friend, he directed his needle to every letter that formed the words which he had occasion for, making a little pause at the end of every word and sentence, to avoid confusion. The friend, in the meanwhile, saw his own sympathetic needle moving of itself to every letter which that of his correspondent pointed at. By this means, they talked together across the whole continent, and conveyed their thoughts across the whole continent, and conveyed their thoughts to one another, in an instant, over cities, mountains, seas, or deserts."

TELEGRAPHIC FEATS.

To the Editor of the Telegraphic Journal.

Sir,—I should not have trespassed on your valuable space again but for the request contained in last week's journal.

A correspondent asks how a sender can be arrested in the middle of a message, or any conversation. I answer, for this reason, after each signal the manipulator or handle in connection with the line is returned to the instrument direct, consequently any signals from the opposite end show themselves immediately, in precisely the same manner as with the bells.

I was fully aware that the Electric Company do not use the ordinary Morse handle, doubtless they have good reasons for adopting Varley's system; the instrument I referred to is the most perfect of its kind, Digney's direct worker.

The advantage of the scrutiniser over the repeater is, that while the sending clerk can go on with his message, the receiver can pay extra attention to any doubtful word, and without much exertion still be in time at the finish to proceed with the next message without causing any stoppage whatever.

I am sorry prejudice has entered the discussion; the only interest I have in the matter is to endeavour, as far as the experience of sixteen years leads me, to further the claims of the instrument that appears in every respect the best for the public service.

I happen to be perfectly acquainted with the bells, not as a clerk, certainly, but have given considerable attention to the construction and capabilities of most if not all instruments in use at the present day.

Reference to my first letter will show that I gave 80 words per minute as the uniform speed.

The term "yarn" was perfectly understood. The mistake was made by "W. H. N.," who said the yarn could not be interrupted, if necessary so to do.

I did not appeal to visitors to judge of the comparative speed. I said *conversation*, which "W. H. N." averred was impossible. I asked *when* the maximum of 50 words per minute was attained?—not, why it was not always.

No inconsistency has been committed on my part respecting the bells. I have given them due credit, only endeavouring to prove the Morse was not inferior. The rule for pausing at intervals does not refer to the ordinary Morse, but to the system used by the Electric Company. I may add, that the speed mentioned by "W. H. N." as despicable to the bells is equally so to the Morse; the great amount of play on the manipulators used by the Electric Company may account for this low rate.

Thanking you for the courtesy displayed in publishing these letters,

I am, Sir, your obedient servant,

Old Double Needle and Morse Clerk.

Dover, March 17th, 1864.

TELEGRAPH CLERKS' PROVIDENT FUND.

To the Editor of the Telegraphic Journal.

Sir,—Pardon me for adding a few remarks to Mr. Newbury's letter of last week. He still seems to be in the dark as to the nature of the rules of a Friendly Society. The members of such institutions can frame supplementary regulations to meet their own specific requirements; but the majority of rules as embodied in the book they are unable to alter without forfeiting the title of a Friendly Society. One of these unalterable decrees is the laws relating to the ills maternity is heir to, and in constructing it the Government have shown their wisdom and their consideration for all parties concerned. I have carefully examined the matter, and having based my calculations upon statistical reports, am fully satisfied that could we make the alteration as suggested by the "ladies' champion," we should find in a few years that three-fifths of our female members would draw double the amount of their subscriptions to provide the necessary indulgences for these happy events, which would prove anything but so few and far between as I think your correspondent imagines. The only remedy is a special provision as suggested. The members of this fund are entitled to free medical advice and medicines in cases of slight indisposition; it is as equally assured to them as the pecuniary benefit, though the latter cannot be obtained unless the member is "laid up." The rule as quoted by Mr. Newbury in no way contradicts this statement. Like your correspondent, I am ignorant of unlawful *manly* sports—the second adjective is a redundancy of his own. These accidents will not average more than one in a hundred of our male subscribers, and will be exceptional cases, while the maternity calls after a time will to a dead certainty affect some 60 or 65 per cent. of our female members; and it must be borne in mind that the fair sex comprise four-fifths of the club at the present moment. The London District Company employ 116 clerks, of whom 55 have already joined the fund. Mr. Newbury has not forgotten to enumerate as one of the advantages of the institution the facilities it affords of becoming acquainted with our fair fellow clerks, and with preternatural sagacity scents matrimony in the distance. This is an advantage that had hitherto escaped my attention, though I can bear testimony to the business-like qualities and general attractiveness of those ladies who compose the board of management of the fund. In laying these statements before your readers I must entirely disclaim any personal feeling in the matter to Mr. Newbury. He saw what he considered defects, and wished to see them remedied; but was imperfectly acquainted with the nature of these supposed drawbacks. His explanations tended to mislead your readers, and were not in many instances in accordance either with logic or the facts of the case. Many of the objections he urged have been explained away; the others are incidental to every friendly society.

London, March 23rd, 1864. One of the Least.

To the Editor of the Telegraphic Journal.

Sir,—Although a warm supporter of the resolution condemning the above society on account of the technicalities, &c., introduced into its rules, I regret that Mr. Newbury has thought fit to stigmatise the correspondence that has appeared in your journal on the subject as "a useless controversy." I think it is rather to be regretted that your correspondents have not been

more numerous, inasmuch as the publication of a correspondence must, if it excites discussion, criticism, and reply, tend to bring out the true state of feeling with regard to a subject; and this testimony of persons immediately interested in the matter is far more valuable than the *ex-parte* assertions of "A Shareholder" and others. Neither can I attach so much importance as Mr. N. appears to do to the paragraph respecting "accouchments." To the best of my knowledge there are very few married ladies in the service of the telegraph companies, and on such "happy occasions" as accouchments husbands are (or ought to be) always willing to meet the incidental expenses, without applying to a society. Great objection is taken to the exclusive character of the certificate to be signed before enrolment, and more especially to the preliminaries to be observed before obtaining relief in cases of sickness. It is well known that all young men are adverse to anything like ceremony, and would, in many cases prefer incurring expense and inconvenience to waiting upon a "minister or magistrate," who might not at such times be the most civil of functionaries. As Mr. N. suggests, the district superintendent would be the most competent judge, he generally being in possession of accurate information. Cannot something be done, Sir, to remedy the defects complained of? Would it not be advisable on the part of the management of the Telegraph Clerks' Provident Fund to invite suggestions from all quarters, and then appoint a committee of inquiry—chosen from those interested—to report upon the best method of modifying the rules accordingly? If this be done, we shall have no more of the jealousies and rivalries which are said to prevent the employés of the different companies from becoming members.—I am, Sir, your obedient servant,

ONE OF THE MANY.

March 23, 1864.

TELEGRAPHIC NEWS.

MR. STANLEY R. BENNETT, of 31, Nicholas-lane, Lombard-street, the professional accountant of the Mediterranean Extension Telegraph Company, has entered into partnership with Mr. W. P. Gaskell, of Bucklersbury, as public auditors.

IMPORTANT SALE.—The collection of pictures, works of art, antiquities, &c., of the late John Watkins Brett, Esq., will be sold, at the rooms of Messrs. Christie, Manson & Woods, 8, King-street, St. James', on Tuesday, 5th April, and following days.

THE TELEGRAPH CLERKS' PROVIDENT FUND.—We have to announce that the British and Irish Magnetic Telegraph Company have given a donation of £15 15s. towards the above fund, and that the Messrs. Rothschild have also subscribed the sum of £10 10s. towards the same object.

MALTA AND ALEXANDRIA CABLE.—It is with the greatest satisfaction that we announce the restoration of the Malta and Alexandria cable, and the opening of the line for public business. We trust that for the future a properly-fitted vessel will be provided, and kept at a convenient port, for the purposes of repair. Surely the loss sustained by the many weeks the cable has been inoperative would have been more than ample to cover the expenses which the maintenance of such a vessel would involve.

CAPE CLEAR TELEGRAPH STATION.—On the 20th instant a large tug steamer, called the Flying Childers, arrived at Cape Clear. She is intended to intercept the American steamers on their homeward passages, and to take the telegrams they bring. This spirited enterprise of the Magnetic Company will, we hope, help to ensure early American news for the public. Despatches by the City of London, landed at 10.40 a.m. on Wednesday, at Cape Clear, were published in the second edition of that day's *Times*

SOUTH AUSTRALIAN TELEGRAPHS.—The number of messages sent through the South Australian Telegraph in 1863 was 86,851, and the receipts £9,885 4*s*. 7*d*. The number of transmitted messages in 1862 was 76,725, and the receipts £8,047 7*s*. 7*d*.; hence the increase of 1863 on 1862 was 10,126 messages, and £1,337 17*s*. in receipts.

THE ATLANTIC TELEGRAPH COMPANY.—We believe that the great improvements effected, the increased knowledge and experience gained of and in the science of telegraphy, will lead to magnificent results, beyond any conceptions yet formed, even in the minds of the most sanguine friends of electrical advancement, and that the exigencies of commerce and civilisation will cause the Atlantic to be traversed by not only one, but by several cables.

DR. ESSELBACH.—The following is an extract from a private letter from Bombay, per the last mail:—"I am sorry to tell you that poor Dr. Esselbach either committed suicide, or fell overboard, a few days before we arrived (in the Assaye). For some time he had been suffering from fever, and had been delirious, but the day the cable was laid between Guadur and Kasab he appeared better. Everyone was so excited over the cable that no one watched him. He was seen wandering about the deck for some time, and afterwards missed. I think that there can be little doubt that he threw himself overboard in a fit of insanity, resulting from the fever. He will be much missed. You would be astonished at the number of things he got at each station for our comfort and amusement."

THE UNITED KINGDOM TELEGRAPH COMPANY.—The above company announce that stations will be shortly opened at the following towns:—Arbroath, Bristol, Cardiff, Dundee, Edinburgh, Exeter, Gloucester, Glasgow, Greenock, Hartlepool, Leith, Newport, Paisley, Perth, Plymouth, Shields, and Swansea.

MISCELLANEA.

CHEAP TELEGRAPHY.—It is now an established fact that a decreased tariff means an increased traffic. Lower the duty on any article of consumption, and the increased demand for it will more than compensate the revenue for the reduction of duty. High fares are always unproductive to a railway company. Excursion trains are invariably crowded by a class of travellers who would never travel at all, or very rarely, if it were not for the attraction of low fares. A newly-constructed railway is sure to create for itself a traffic, both in goods and passengers, which did not previously exist. No better illustration of this principle can be brought forward than the present penny postage. With a postage traffic of tenpence the number of letters sent was exceedingly limited, and mercantile and business transactions were cramped and retarded; and to nothing is this principle so peculiarly applicable as the electric telegraph. There can be no doubt that, from the high rate of charges for the transmission of messages, the great mass of the people were for a long time excluded from the daily use of the telegraph. The community at large had no more idea of sending a telegraphic message, except on some very extraordinary occasion, than they would have of writing the number of letters they do if the old rate of postage was in force. Still, the use of the telegraph, although considerable reduction in the prices has taken place, is not familiarised to the minds of the masses, except as something to fly to on an emergency; the excess over the shilling excludes it from being so extensively used as it ought to be. What is wanted is, to bring the telegraph within reach of the great mass of the middle classes, who would use it if the charges were from sixpence to one shilling, or even less for short distances, and for a certain class of messages. When Mr. Thomas Allan first proposed a cheap system of telegraphy he found but little favour or encouragement. It is now, however, clear that cheap telegraphy is feasible, and that it is remunerative also, as evidenced by the rapid extension of the shilling system in England.

POLICE TELEGRAPH.—Captain Charles Hodgson, the Superintendent of the City of London Police force, speaking of the value of the telegraph for police purposes, states:—By its means, information is immediately transmitted from the several divisions of the chief offices of all occurrences of an important character, of which particulars were, formerly, only supplied every twenty-four hours. So, likewise, any matter of which it is desirable to send notice speedily to the different stations, is now telegraphed, instead of being sent round in writing by a messenger—a course that formerly occupied about two hours. The telegraph is also found very convenient in promptly obtaining from a division any particulars required relating to matters under investigation at the chief office. On the occasion of fires or other unforeseen emergencies, the telegraph has been found especially useful, not only in conveying the information from station to station, but in enabling the officers to collect from all the stations the requisite number of men, without denuding the streets in the immediate neighbourhood of the occurrence of the constables in charge of beats. As an illustration of its value in this respect, I may instance the occasion of the great fire in Tooley-street, when London-bridge and the city side of the river were, for a considerable period, occupied by a vast and excited crowd, which required the greatest exertion of police authority to control, and, through which, only by the greatest effort could the circulation of traffic be maintained. The large number of the City police so engaged were drawn from the several divisions by a series of telegraphic messages, as the increase of the fire, and the accumulation of spectators, made hourly additions to the strength of the police necessary. A further, and by no means unimportant, aid rendered by the police telegraph, is in the general facility it affords to officers in charge of divisions of conferring with the chief office on matters presenting unusual difficulties, and of communicating with the superintendent, at his residence, at any hour of the night. For these reasons I consider the telegraph most valuable to the force, in economising time, and giving to its officers more direct control over its resources.

ELECTRO-GALVANIC CLOCKS.—The *Malta Observer*, of the 22nd February, says:—"It affords us much pleasure to notice the erection in this City of several public time-keepers, placed within very handsome lanterns, and illuminated by gas at night-time. A great boon has already been conferred upon the public by having these clocks at the landing places—the Custom House, Marina, and at Marsamuscetto Gate—localities in which the want of a time-piece was often and greatly felt; and we are pleased to observe that the electric clocks in these convenient localities are placed within a suitable height, so as to be easily noticed by any passer-by. Another electric clock had been put up in front of the Main Guard at an elevation of about 25 feet or more, where it certainly appeared to every one rather small and insignificant; but we are glad to see that his Excellency the Governor ordered its removal from that inconvenient height, and instructed Mr. Rosenbusch to put it up in the same locality at an elevation of about ten or twelve feet from the ground, where certainly it will be most useful and form at the same time an ornament to the Main Guard Station itself. It is proposed to place similar electric clocks at the following places:—The Palace of Justice, Union Club, Porta Reale Gate, Peninsular Company, and the Market. We heartily congratulate Mr. Rosenbusch upon the success he has achieved in this respect, and hope that he will be equally successful in all his future undertakings. Great credit is due to him for

having started the proposal, the introduction of electric clocks being yet very limited. We propose on another occasion to give some information as to the simultaneous working of these clocks, and show how the regulator clock at the Palace (made by the far-famed Brégnet of Paris) sends an electric current once a minute, and how this flash of lightning swifter than thought moves on the fingers of all dials in the gas lanterns. We are happy to add that his Excellency the Governor has really introduced a most novel, beautiful and useful thing in this city, and we sincerely hope that the time will not be far off when every commercial office, nay every man's house in Valletta will have an electric current sent from the Palace, which will record itself on a clock to keep time simultaneously in many hundreds of others, and require no winding up."

Persons unqualified for Telegraphy.—There are many persons who seem totally incapable of acquiring a knowledge of the art of telegraphy, sufficient for practical use, while others, and especially young persons, will acquire it even in the short space of a fortnight, sufficiently to transmit and receive dispatches with considerable facility. A ludicrous example of this lack of ability to operate this simple apparatus came to our knowledge quite recently. A middle-aged man, employed upon one of our rail-roads, as depôt-master and telegraph operator, found great difficulty, after two years' experience in operating the instrument, and this inability extended to his reading, as well as his transmitting dispatches. Upon one occasion, he rushed out of his office in a great state of excitement, and informed the conductor of a train, which had just arrived at his station, that he had just received a dispatch stating that the —— train had broken both driving wheels, and was badly smashed up; no more trains must post until further orders. The conductor, who was able to read the telegraphic characters, went to the instrument, and, drawing out the paper, read the following dispatch:—"Ask the conductor of the Boston train to examine carefully the connecting rods of both driving wheels, and, if not in good condition, to await orders." The conductor, having made the examination in company with the engineer, and found all right, gave the order for the train to move on, to the infinite astonishment of the *soi-disant* operator, who never was able to find out why the conductor had the temerity to order the train to go on under such grave circumstances. In the same village where this *reliable* operator is employed, there is another telegraph office, where the ordinary telegraph business is done, and, whenever our friend receives a call upon his instrument, he gives the signal to go a-head, and, after receiving the dispatch, takes it to the operator at the other office, to have it translated for him. Not long since, he rushed into the office with a strip of the telegraph paper in his hand, and cried out, "I want you to read this for me, quick; I expect there's some awful accident on the road, the operator rattled away so fast when he sent it." The operator took the strip, but, to the dismay of the nervous visitor, a large portion of it had been torn off by a dog who was attracted by its singular appearance, as it streamed behind him while he flew along, and the part which remained, contained only these words:—"Good morning, Uncle Ben. When are you ——." The dog had swallowed the rest.—*Prescott's History of the Electric Telegraph.*

Remarkable Telegraphic Experiment.—Being at Paris some years ago, I was engaged to share with M. Leverrier, the celebrated astronomer, and some other men of science, in the superintendence of a series of experiments to be made before committees of the Legislative Assembly and of the Institute, with the view of testing the efficiency of certain telegraphic apparatus. On that occasion, operating in a room at the Ministry of the Interior appropriated to the telegraphs, into which wires proceeding from various parts of France were brought, we dictated a message, consisting of about forty words, addressed to one of the clerks at the railway station at Valenciennes, a distance of 168 miles from Paris. This message was transmitted in two minutes and a-half. An interval of about five minutes elapsed, during which, as it afterwards appeared, the clerk to whom the message was addressed was sent for. At the expiration of this interval the telegraph began to express the answer, which, consisting of about thirty-five words, was delivered and written out by the agent at the desk, in our presence, in two minutes. Thus, forty words were sent 168 miles, and thirty-five words returned from the same distance, in the short space of four minutes and thirty seconds. But, surprising as this was, we soon afterwards witnessed, in the same room, a still more marvellous performance. The following experiment was prepared and performed at the suggestion and under the direction of M. Leverrier, and myself:—Two wires, extending from the room in which we operated to Lille, were united at the latter place, so as to form one continuous wire, extending to Lille and back, making a total distance of 336 miles. This, however, not being deemed sufficient for the purpose, several coils of wire wrapped with silk were obtained, measuring in their total length 746 miles, and were joined to the extremity of the wire returning from Lille, thus making one continuous wire making 1,082 miles. A message consisting of 282 words was then transmitted from one end of the wire. A pen attached to the other end immediately began to write the message on a sheet of paper moved under it by a simple mechanism, and the entire message was written in full in the presence of the Committee, each word being spelled completely and without abridgement, in *fifty-two seconds*, being at the average rate of *five words and four-tenths per second!* By this instrument, therefore, it is practicable to transmit intelligence to a distance of upwards of 1,000 miles, at the rate of 19,500 words per hour! The instrument would, therefore, transmit to the distance of 1,000 miles, in the space of an hour, the contents of about forty pages of the book now in the hands of the reader! But it must not be imagined, because we have here produced an example of the transmission of a despatch to a distance of 1,000 miles, that any augmentation of that distance could cause any delay of practical importance. Although the velocity of the electric current has not been very exactly measured, it has been established beyond all doubt that it is so great that to pass from any one point on the surface of the earth to any other, it would take no more than an inappreciable fraction of a second. If, therefore, the dispatch had been sent to a distance of twenty thousand miles instead of one thousand, its transmission would still have been instantaneous. Such a despatch would fly many times round the earth between the two beats of a common clock, and would be written in full at the place of its destination more rapidly than it could be repeated by word of mouth. When such statements are made, do we not feel disposed to exclaim—

> "Are such things here as we do speak about?
> Or have we eaten of the insane root,
> That makes the reason prisoner?"

In its wildest flights the most exalted imagination would not have dared, even in fiction, to give utterance to these stubborn realities. Shakspeare only ventured to make his fairy

> "Put a girdle round the earth
> In forty minutes."

To have encircled it several times in a second, would have seemed too monstrous, even for Robin Goodfellow.—*Dr. Lardner on the Electric Telegraph.*

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine mixed, first and second qualities....	2/3 to 2/6 per lb.
Good re-boiled....................................	1/7 to 1/10

India Rubber.

Para, first quality	1/10 to 1/11	„
second „	1/7 to 1/8	„
third Negro-head	1/2 to 1/3	„
Java and Penang	1/4 to 1/6	

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	
Stock	Electric Telegraph . . .	100	102 to 105	
100	Submarine Telegraph, scrip. .	all	48 to 53 x d	
all	Do. registered	all	⅛ to ½ x d	
5	United Kingdom Telegraph .	3	1 dis. to par	
10	Mediterranean Extension Tel. .	all	3 to 4	
5	London District Telegraph Co..	all	1½ to 2	

TO CORRESPONDENTS.

G. L. W.—Your communication will receive consideration next week.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)............	0	3	0

THE TELEGRAPHIC JOURNAL.

VOL. I. No. 14.—APRIL 2, 1864.

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REMUNERATIVE SPEED ON SUBMARINE CABLES.

THE speed of transmission through submarine cables has been greatly accelerated in consequence of the great improvements which have been effected in galvanic batteries, in the conductivity of copper, in the insulating material, and in signalling apparatus. The following record of the number of words transmitted through various submarine telegraphs in their submerged and working state will enable our readers to compare the past and the present attainable speed:—Through the Varna and Balaclava cable, 310 nauts in length; copper conductor, $\frac{1}{16}$-inch in diameter, covered with gutta-percha to No. 1 gauge; 5 words per minute. The Atlantic Telegraph cable of 1858: length, 2,500 miles; weight of copper per knot, 107 lbs.; weight of gutta-percha per knot, 261 lbs.; maximum speed, 2½ words per minute. The Red Sea cable: length, 730 knots; weight of copper, 180 lbs. per knot; weight of gutta-percha, 212 lbs. per knot; rate of speed, 7 words per minute. The Malta and Alexandria cable: length, 1,260 knots; weight of copper, 400 lbs. per knot; weight of gutta-percha, 400 lbs. per knot; speed attained, 10 words per minute. The new Atlantic cable: length, 1,880 knots; weight of copper, 300 lbs.; weight of gutta-percha, 400 lbs.; rate of transmission experimentally ascertained by Mr. C. F. Varley, electrician to the Electric and International Telegraph Company, and Professor Thomson, F.R.S., to be 8 words per minute, and this high speed may be much increased by a proper system of abbreviation and coding.

The Morse instrument employed for the measurements of speed, as above enumerated, has been greatly improved within the last few years, and we believe that other valuable modifications are being carried out which will still render the apparatus far more efficient and rapid in its action. The Hughes instrument, now about being employed on the Persian Gulf cable, is exceedingly well adapted for working long lines of submarine telegraphs. It has the great advantage that it prints one letter with every wave, or with every current. We ourselves have had frequent and ample opportunities of witnessing the great rapidity and accuracy with which the machine worked at the rate of 16 words per minute through a cable which would only permit of 6 or 7 words per minute being sent through the ordinary Morse. There are other instruments capable of rendering efficient service, and we have no doubt the directors and advisers of the Atlantic Telegraph Company will ensure the employment of those which will be found the best adapted for the development of the great undertaking.

Having endeavoured to place before our readers a brief history of the progress which has taken place in the science of submarine telegraphy, we shall now take into consideration the commercial aspect of the Atlantic Telegraph undertaking. Circumstances combine to render the prospects of the Company brighter and more promising day by day—inland telegraphy becomes more remunerative—an important submarine cable successfully submerged in the far East—the Malta and Alexandria cable restored—public confidence re-established, and more than ever impressed with the value of telegraphic communication. We have already stated that the new cable to cross the Atlantic is to be constructed to ensure a working speed of 8 words per minute. If we were to reduce the attainable speed of 8 words even to 6 words per minute, the full employment of the line would render the undertaking exceedingly profitable. The following would be the result:—Six words per minute would give 360 per hour, or 8,640 per day of 24 hours, which it would be necessary to occupy in consequence of the vast amount of business which would have to be transmitted. Allowing 300 working days in the year, the number of words which it would be practicable to transmit would amount to 2,592,000, or 129,600 messages of 20 words each per annum, being at the rate of 432 per day, which, at £5 per message, would yield a revenue of £648,000, and, after allowing out of this sum £216,000 for contingencies, there would remain a net revenue of £432,000, as the result of 300 days' operation, at the end of the year. The disbursements, it is believed, may be estimated as follows:—Working charges at stations in Ireland and Newfoundland, and office expenses in London, £15,000; dividend of 8 per cent. on preference stock, £48,000; 5 per cent. interest on bonds, £5,000; and 4 per cent. dividend on old stock, £24,000; amounting in the aggregate to £92,000, which, being deducted from the net revenue as above specified, would leave a balance of £340,000, which would pay an additional dividend of more than 25 per cent. upon the whole capital, old and new, of £1,300,000, and making up the dividend upon the preferential stock 33 per cent., and on the old stock 29 per cent., leaving a surplus for contingencies of £40,000, besides the subsidies for 25 years, each from the English Government, £20,000 per annum, and the United States, £14,000 per annum, and the discounts agreed to be made by other telegraph companies on all business passing over their lines to and from the cable. That the above estimated amount of income on a line capable of transmitting 8 words per minute will be realised, the operations of the Malta and Alexandria line afford unquestionable proof. In the above estimate we consider that we are far below the actual receipts which may be reasonably anticipated from a line uniting the vast social, commercial, and political interests of the Old and New World. In conclusion, we most heartily congratulate the directors and the shareholders on the present prospects of the Company.

BONELLI'S ELECTRIC TELEGRAPH COMPANY.

UNTIL society attains to that Elysian condition when each member of the community shall feel another's good to be his own; until men, abnegating self, labour for the public weal; so long will competition prove the only means of restricting monopoly, and ensuring to trade and commerce due development. The inventive faculties of man seem to receive a stimulus to exertion in the contemplation of how best to supersede the devices and productions of his fellow, and we accordingly find improvement succeeding improvement, until the old world of inventions passes away before the new era, to disappear in its turn. It is well. The onward march of civilization opens up requirements undreamt of by philosophers, extatics, or poets; and when we find this ever-yielding law of progress suspended, when science is at a standstill, when art declines, and when the multitude of tributaries to national wealth cease to flow, then—but not till then—dare we murmur. We live for the future, and hail with welcome every advance towards perfection in the applications tending to human convenience and felicity. Science

has surrounded the peasant of the present day with greater comforts, personal and domestic, than were enjoyed by the peer, yea, the prince of the last generation. It has made steam our handmaiden, the earth our messenger, and lightning, once a terror, is now a voice which enables us to communicate our thoughts and emotions to distant friends, and to receive expressions of their sympathy, be they at the ends of the earth, in a second, thus obliterating time and space.

The various applications by which we are now able to effect these latter results, have been brought from the simple to the compound, from the incomplete to the comparatively perfect form in a few years; and as improvement has succeeded, step by step, in supplanting old instruments, the interested outcry against innovation has been raised, and we know of valuable inventions suppressed, lest rivalry should induce a disastrous competition. Progress may be retarded, but it cannot be seriously influenced by these petty devices of the shortsighted and the ignorant; and now, notwithstanding many adverse circumstances encountered, we have to announce the successful establishment of a company, to employ the beautiful transmitting and printing telegraph of the Chevalier Bonelli. This project, which has been nurtured by Mr. Henry Cook since the year 1851, has now assumed a character and importance demanding more than a passing notice. The Company, which was originally established with a capital of £25,000 for the purpose of effecting telegraphic communication between Manchester and Liverpool, proved, beyond expectation, the excellence of the Bonelli system. The directors, encouraged by the success which has hitherto attended their transactions, have determined to extend their operations to the principal centres of commercial activity, and with this view have issued new shares, raising the capital of the Company from £25,000 to £250,000, which will enable them to complete arrangements with Chevalier Bonelli for the entire patent-right for the United Kingdom, and to commence operations on the proposed enlarged footing.

It is confidently expected that by thus extending to all the important districts of England the advantages, practical and economical, possessed over every other system of telegraphy hitherto in use by the Typo-Electric Telegraph, and through the reduction of the tariff, which its employment allows, to a uniform rate of sixpence per ordinary message of twenty words—placing the boon of telegraphic intercommunication within reach of the masses—new and boundless sources of business, and, consequently, of profit to the shareholders, will be created, while to all who already use the Electric Telegraph will be secured, for the first time, that rapidity, correctness, and punctuality, which, from the nature of the agent employed, the public had a right to expect, but which has never yet been practically attained.

The prospectus of the Company is before us, and the recommendations of their system are thus set forth:—

First. Each message is printed by the very act of transmission, in clear Roman characters, and as so transmitted is delivered, without further process, to the receiver, thus absolutely excluding all possibility of error from any source existing between the sender and the receiver.

Second. The extreme rapidity with which messages can be transmitted in succession, resulting both from the nature of the apparatus and its non-liability to error, not only allows these instruments to keep pace with the largest amount of business within the experience of existing establishments, but places them beyond all likelihood of being overtaxed, even by the increased pressure of work that must inevitably ensue from a uniform sixpenny rate for the ordinary message. This rapidity and certainty of working applied to the requirements of journalism must naturally produce results even more marked; and it has been proved by practice that a speech which, by the ordinary instruments occupied six and a-half hours in transmission, could, with an equivalent staff, be printed off by the Bonelli Telegraph, in an immediately legible form, in the space of one hour and a-half. No less emphatically does the instrument recommend itself to members of the Stock Exchange, to whom it ensures that absolute accuracy, united with exemption from delay in communicating with their correspondents, which cannot be invariably counted on under existing systems.

Third. The automatic nature and simple working of the Bonelli instrument, renders it independent of specially trained, and therefore highly paid, manipulators.

Fourth. The necessity to which all other telegraphic establishments are exposed, of increasing the staff of operators, in proportion with the augmentation of business, thus involving an enormous and comparatively unprofitable expenditure of capital, or the forfeiture of public patronage, does not exist where Bonelli's instruments are employed, and consequently, all increase of business must prove almost absolutely clear profit.

In submitting the claims of this Company, the directors have expressed their confidence in being able to supersede the old systems of telegraphy as completely and as universally as steam and the rail have supplanted the stage and the post road. The Company has been received with considerable favour by the public, which augurs well for all parties interested in the success of the undertaking. When the projected lines are completed, this Company will be able to compete with existing establishments, and thus determine the relative merits of the different transmitting apparatus, and, as they propose a very great reduction in charges, cheapen telegraphy, and bring it into more general use.

There is scope enough in England for the extension of the telegraphic enterprise; hence we note with satisfaction the advent of the new company. In 1850 the number of messages transmitted in this country was 64,734; in 1862 they had increased to upwards of 2,000,000, or 2,300 per cent. This vast increase is to be attributed mainly to the reductions which have been made from time to time in the tariffs, and we fully anticipate that when the use of the wire is placed within the reach of the masses, the telegraphic system will be as generally adopted as have been the schemes of Rowland Hill.

FAULTS IN INSULATION.

We quote the following remarks upon the above subject from the Government Report, at the request of an esteemed correspondent. The suggestions of the writers deserve every consideration on the part of those engaged in the manufacture and management of submarine cables. The experiments prove the necessity of having a considerable portion of the ends of a submarine cable furnished with the best material, and the most perfect insulation:—"I will next consider the action of a battery upon these small faults, and the importance of this point cannot be overrated. First under this head I will examine the degree in which faults are subjected to the action of the battery, according to their position in the cable, whether near the battery, or at a distance from the battery. The internal wire of a submerged cable, charged by a battery, may be considered as one source of electricity; the water surrounding the cable as a second source of electricity; the potential of the latter source being zero. The potential of the internal wire of the cable, when perfectly insulated at all points, is equal to the potential of the pole of the battery with which it is in connection. In a well-insulated cable this is sensibly the case, when one end of the wire is connected with the battery and the other end insulated. When, however, the other end of the wire is connected with earth (as when signals are being sent), the potential of the internal wire varies at every point. Close to the battery, the potential is still equal to that of the pole of the battery with which it is connected; close to the end of the wire which is connected with earth, the potential at the wire is zero. At intermediate points the potential diminishes in direct proportion with the distance of each point measured by electrical resistance from the pole of the battery; thus, midway the potential is half that of the pole of the battery, and so on. This law obviously only holds good so long as the fault offers a resistance, as large as compared with that of the portion of conducting wire between the fault and the end connected with earth. Some slight divergence from the law described will also occur in a cable which is not perfectly insulated, but which is equally insulated through its entire length, as in the case of a sound gutta-percha cable. It is not now, however, necessary for my purpose to investigate the precise sequence of the potentials at the consecutive points of such a cable, although this may some day become a valuable test. My wish now is only to show to what extent a battery extends its full power on defective

portions of a cable at different points of its length. From what has just been said, it results that if 100 cells are used in signalling through a cable 500 knots long, a fault which exists midway will only be subjected to a statical power equal to that of 50 cells, applied directly at the spot where the fault exists; and a fault 400 knots distant from the battery would only be subjected to a statical power equal to that of 20 cells. When, however, signals are sent from the opposite end, this latter fault will be subjected to a power equal to that of 80 cells. When there are several faults in a cable, the potential at different points of the wire no longer varies in direct proportion with the linear distance from the pole of the battery, as is the case in a sound uniform cable, but diminishes rapidly after each fault; the larger the fault, the greater the diminution of potential in the wire beyond it. Each fault, as it were, protects those parts of the cable beyond it from the full action of the battery, and thus it may happen that mending one fault close to shore may cause a fault at a greater distance to deteriorate rapidly, under the action of a battery which had not before injured it (assuming, for the moment, that the action of a battery is detrimental). From the above considerations, we see that a fault near one end of a cable may be uninjured by signals sent with an equal battery in the opposite direction. We also see that a cable is more severely tried in some respects at all points distant from the shore, when tested for insulation, than when used to transmit signals, the battery remaining the same."—*Fleeming Jenkin, Esq., C.E.*

"We obtained similar measurements of 554 miles of cable, of which, 154 miles consisted of the least perfect cable, and the remaining 400 was the length newly manufactured of standard wire. The results were very different, according as the standard length, which is well insulated, was nearest the battery power, or farthest from it. The following are the reduced details of the two cases:—1st standard wire at home end, entering current, 1·000; signal fork (far end), 0·775; leakage (circuit complete), 0·245; leakage (far end free), 0·798. 2nd standard wire at far end, entering current, 1·000; signal fork (far end), 0·485; leakage (circuit complete), 0·515; leakage (far end free), 0·937. These measurements show that the greatest advantage is gained out of the best specimens of cable by having them nearest to the source of electricity, or at the shore end. The advantage gained in the above two modes of arrangement, is as 755 to 485, or as 1½ to 1. The good specimens of 400 miles is at the bottom of Niagara coil, and comes out last. Should her portion of the cable become so exhausted that this will become the first length from Newfoundland, it will be in the best possible position. Should the first lengths from either shore consist of the worst specimens, they will be in the least advantageous position."—*C. V. Walker, Esq., F.R.S.*

THE INDIAN TELEGRAPH.

THE tame lightning, obedient to the hands that drew it down from heaven and manufactured the long wires for its path, begins to cross and recross the earth in every direction, bearing our instantaneous messages. Long ago we ought to have been in momentary communication with America—the electric telegraph *has* made the continents speak together; but, thanks to the lingering civil war, America and Europe are still as far apart as if Wheatstone's wonderful invention were yet to be proclaimed. But elsewhere good work is doing. The snake-like cables are stealing over the lands and under the seas, linking countries and continents closer and closer together. The Indian telegraph will soon be an accomplished fact. The line is laid, by the last despatches, all the way from Kurrachee to Mussendom; and the steam-consorts of the expedition had towed the Kirkham and Marian Moore empty to Bombay, to fetch up the Tweed and Assaye, which had on board the remaining 730 miles of the cable for the Arabian Sea. The line is thus laid already from the mouth of the Indus to Ras Noo on the Mekran coast, and from Ras Noo to Mussendom—altogether about 360 miles, and some of it over the worst part of the sea-bottom. It has gone down to its bed in those astonished waters with undiminished electrical insulation; the messages go sharp and crisp to Kurrachee; and thus far the wonderful undertaking is a complete success. It has yet to thread the Persian Gulf to Bussorah, thence to find its way among wild tribes and ruined cities to Baghdad; and when the line shall be thus far finished, India will be but a few hours distant from England—indeed, as the sun is earlier there than here, we may some day obtain a message rather before the minute at which Calcutta or Madras despatched it. What miracle in old religions is really greater? The accounts of the successful expedition tells us of the astonishment of the savage Beloochees and Arabs along the Mekran, at this marvel of a blue spark flashing for the Sahebs to Indus and back again in the time that it takes to "smoke a hookah." There is a town upon the sandy shore there called Gwadur, at which one station of the line has been fixed. No sooner was it landed there, than the people of the surrounding country flocked down to hear and talk of the Feringhee witchcraft. Chiefs of the Beloochees, Muscatees, and Heratees, with their retainers, trod upon each other's toes in their eagerness to see "the strings" at work. Gwadur has deliberately given up the idea that Mahomet taught everything that could be known; Gwadur "sits upon the carpet of astonishment, and chews the betel-nut of meditation." It is only to be hoped that the roving Kurds and Iranistan robbers about the head of the Persian Gulf, will be afflicted in the same way—with wonder, instead of cupidity or fanaticism; then the Arabian sea telegraph will, before long, link all the systems of Europe with that which binds together the capitals of India.

Telegraphic engineering has a curious history, and few passages in it are more creditable than the way by which the lines were established which we shall join when the wire passes down from Kurrachee to Bombay. Thanks to Lord Dalhousie, and to his scientific lieutenant, Sir William O'Shaughnessy, Bombay, Calcutta, and Madras have long been united by the electric line. But it was a singular problem that presented itself to that clever Deputy Assay-Master of the Mint when, with his chief's encouragement, he turned his hand to creating telegraphs for India. Let no one suppose that it was merely an affair of constructing a battery, laying the wires, nominating staff, and then the thing was done. In the first place, Sir William discovered that the air of India is in a state of constant electrical perturbation of the strongest sort, so that the instruments then mounted went into a high fever, and refused to work. Along all his north and south lines, he found a current of electricity constantly passing, which threw the needles out of gear and baffled signallers. Moreover, the tremendous thunder-storms ran up and down his wires, and melted his conductors; the monsoon-winds tore his teak-posts out of the sodden ground, and elephants and buffaloes trampled the fallen lines into kinks and tangles. The cotton and rice boats, "kedging" up and down the river, dragged his subaqueous wires to the surface. These were some of the serious Indian difficulties; but over and above them, which he met in various and ingenious ways, there were *quasi*-ridiculous obstacles. Wild pigs and tigers scratched their skins against his posts in the jungle, and porcupines and bandicoots burrowed them out of the ground. The Delta aborigines carried off his timber supports for fuel, and the wires or iron rods upon them to make bracelets and Hindoo smitheries. If those left them alone, kites, fishing eagles, and hooded crows came in hundreds and perched upon the line, to see what on earth it could mean; and sometimes after a thunderstorm, when the wires were wet, were found dead by dozens, perished through their curiosity. Monkeys climbed the posts and ran along the lines, chattering, and dropping an interfering tail from one wire to the other, which tended to confound the conversations of Calcutta. Parrots hung upon one string by the beak and another by the leg, with the same contempt for electrical insulation; and in one village the complacent natives stretched their fishing-lines to dry upon them. Sir William O'Shaughnessy had to encounter and conquer all these odd and unexpected mischances, before he proved, by his experimental line and self-invented machines, that all the peninsula could be covered with telegraphs at £500 per mile. To him in the first place, and to Lord Dalhousie in the next, it was due that the idea was carried out. In 1856, there were 4,000 miles of telegraph stretched over India—some upon bamboo posts, which bent to the storms, and thus defy them—some, as in the Madras presidency, upon monoliths of granite—all serviceable; and in the mutiny they proved to be worth ten times their cost.

The telegraph, indeed, so far saved India, that it spared us the disgrace of being beaten down to our ships and the sea-coast, during the awful hour of suspense while succour was coming. The Anglo-Saxons were quickly warned, by the wonderful "vidette" they had introduced, of the approach of the frantic soldiery, and so found time to gather in little knots, and present the front that defended station after station. But for the telegraph, established in spite of all these curious obstacles in the animal and atmospheric world, the first news of the rebellion, even in Agra as at Delhi,

might have been the inroad of savage Mussulmans proclaiming their message by the colour of their hands. The electric spark ticked the word "rebellion" over English India, and the Englishmen stood on their guard. These days are past, however, and the telegraph lines now stand ready to be linked with ours in Europe, as part of a united network which will help to bind the world together. Already, a company proposes to carry a communication to Rangoon, Singapore, and the north coast of Australia southwards from Calcutta, and to Hong Kong and Manilla northwards. As lines increase, they breed lines; new trials and experiments avert failures; habit of such lightning-like ease of communication makes it indispensable. When Calcutta talks to London at breakfast time, and gets her answer before tiffin, we shall not wait much longer ere Puck's girdle shall be put round the world in less than "forty minutes."—*Daily Telegraph.*

THE EARTH AS A CONDUCTOR.

By G. B. Prescott, Esq.

We will here say a few words upon the important part played by the earth when it is employed as a conductor in the operations of electric telegraphy. We have already seen that the idea of employing the earth as a conductor between two telegraphic stations, realised for the first time by Steinheil, had permitted the suppression of one of the conducting wires, and thus the realization of great economy and simplicity in practice. It was at first supposed that the ground played the same part as the conductor for which it was substituted, and that there was established between the two poles of the battery placed in communication with the earth, even when they were at a great distance apart, a veritable electric current, transmitted through all the interposed conducting matters, and which the earth always contains in greater or less proportion. The terrestial globe cannot be considered as being in its nature so perfect a conductor as a metal, but its bad conductibility is found to be more than compensated by the immensity of its section. We may therefore consider the earth as presenting a null resistance to conductibility. MM. Bréguet and Mattencci, by various experiments, found that where the current went by the copper wire from Pisa to Pontedera, and returned by the earth, its intensity was the same as when the two poles of the battery were immediately united by a single copper wire as long as that by which the two stations were connected. This experiment, and a great number of other similar ones, enable us therefore to admit that the resistance of the earth to electric conductibility is null. Electric currents, we must admit, are able to cross each other in all directions, and at every instant, without affecting each other; and we must suppose that, between two stations very far apart, such as New York and Buffalo, there is a series of decompositions and recompositions of all the interposed molecules of water, and that the positive electricity, for example, that is introduced into the ground at New York cannot be neutralized except by the negative arising from the same battery, but brought by the telegraph wire into the ground at Buffalo, a neutralization going on from molecule to molecule, through all the conducting sections that are found in the terrestial globe between these two stations. It is likewise necessary to admit, when the positive and negative poles of several batteries are plunged at the same time in the ground at great distances from each other, that the positive electricity of each pole, in order to become neutralised, seeks for the negative electricity of the pole belonging to the same battery, even though this pole might be much more distant than the negative of another battery. This hypothesis of the predisposition of the two electricities to neutralize each other only when they arise from the same source, appears to us equally contrary to logic and to observation. We must therefore have recourse to another explanation of the part played by the earth in the phenomena of electric conductibility,—an explanation which flows very naturally, from the fact observed by Faraday and Wheatstone with electric cables. This fact is that of a vast reservoir—of a species of drain—which sucks up and absorbs, at the two extremities of the wire, the free electricities which the battery, or any apparatus that is the generator of electricity, sends into it. By the very fact that this electricity is lost or escapes, there is an electric movement, and, consequently, a production of a current. M. Magrini, in experiments made with long, well-insulated telegraph wires, extending from Milan to Menza, had already shown that an electric current might be obtained in a wire of which only one of the ends communicated with a source of electricity, whilst the other remained insulated; but, in this mode of operating, some defect of insulation might be feared. This fear disappears on the experiments of Faraday and Wheatstone. These latter very clearly show us that it is enough to put into communication with one of the poles of a battery, the end of a conductor of very great dimensions, the other extremity of which is insulated, in order that this conductor, in becoming charged, may be traversed by an electric current, the pressure of which is indicated by the deviation of the needle of a galvanometer. The same phenomenon takes place with the earth, with this difference, that the terrestial globe being a conductor of infinite dimensions, the current is able to endure as long as the communication of the pole with the ground takes place.

M. Mattencci, who has greatly directed his attention to the conductibility of the earth, had made the curious remark, that when the electrodes are plunged into the ground to a suitable depth, the resistance of the interposed layer increases exactly with its length, according to the recognized law for ordinary conductors; there is not even any difference, when the layer is very thin, between its resistance and that of the same layer of earth or water contained in an insulated vessel; but if the distance between the electrodes becomes considerable, the resistance of the terrestrial bed diminishes very rapidly; even at the distance of from sixty to one hundred yards, the current ceases to diminish; at greater distances its intensity increases until it becomes equal to that which would be found with the circuit entirely metallic. This result is always verified for distances of ten or twelve miles. The increase of the current with the length of the terrestrial bed is independent of the nature and form of this bed; it was before having arrived at the length of the bed at which the resistance ceases that the influence was observed of the nature and form of this bed over this same resistance.

This observation of M. Mattencci clearly shows us that the earth is able to play two very different parts in the transmission of currents. It is able to discharge the function of an ordinary conductor when the electrodes are very near to each other; and then the resistance, which it opposes to the current, increases with the length of the interposed terrestrial bed; but when the distance between the electrodes attains to a certain limited dimension the earth acts as a reservoir, which absorbs the electricities liberated at each of the poles; its resistance then disappears, and the intensity of the current depends on nothing more than the resistance of the conducting-wire alone; so that the intervention of the terrestrial globe presents the double advantage of permitting the economy of one line wire, and of rendering the current twice as strong as it would be were it made to return by the second suppressed wire. The results obtained by Mattencci in his experiments have been verified by our own in a somewhat different manner. A telegraph line of one mile in length, extending from the counting-room of the Bridgewater Iron Works to the works themselves, furnished with a current of five Daniell's cells, had never worked well, the current being always weak and shaky. We were finally called upon to solve the difficulty, and after satisfying ourselves that the connections were perfect, decided that the earth's termini must be imperfect, not being of sufficient depth to overcome resistance. We accordingly attached a copper wire, and ran it into the canal, when the intensity of the current at once increased to the full amount desired. Subsequently, upon our explaining to Mr. Sprague, the operator, the laws of transmission and resistance—that the resistance of the earth was in the inverse ratio to the surface of the metal buried—he attached a plate of copper to the wire, and placed that in the canal, when he was able to reduce the intensity of his battery one-fifth, and still have a stronger current than before. The difference between what takes place when the electrodes are near together, and what takes place when they are far apart, may seem extraordinary at the first moment; but upon reflection, we easily conceive that in the former case the molecules interposed between the two electrodes, not being so numerous, may constitute the electric chain by the effect of the mutual neutralization of their opposite electricities, which is preceded by their polarization. When the electrodes are very distant this communication between them can no longer take place, and they are then discharged, by means of the bed with which they are in contact, into the entire mass of the terrestrial globe.

Besides, many other facts of a different kind demonstrate that it is not necessary, in order to obtain a current, to re-unite the two contrary electricities produced by the same electrical apparatus,

but that it is sufficient that one of the two electricities be absorbed. Thus it is that when the outer coating of a Leyden jar is placed in communication with the ground, we are able to obtain a discharge in the air similar to a current by furnishing its inner coating with a point.

The part played by the earth in the transmission of telegraphic despatches is, therefore, in accordance with a very great number of phenomena of the same kind, which have demonstrated to us that the propagation of electricity, and consequently the production of an electric current, may take place in a conducting body as well when this body is placed in communication with another charged with an excess of one of the electricities only as when it is found placed between two excesses of contrary electricities. When the terrestrial globe is employed for bringing about the circulation of a current in an insulated conductor, one of the extremities of which communicates with one of the poles of a battery and the other with the ground, whilst the second pole of the battery also communicates with the ground, care must be taken to establish these communications well. With this view, the conducting wires that go to the earth terminate in large metal plates, generally of copper, which are also buried as deep as is convenient in wells, or in the most moist parts of the ground that can be found. The gas and water pipes of towns are advantageously employed for obtaining good communication with the earth; and iron fish-jointed rails are valuable, in country stations especially. Upon nearly all telegraph lines where an intermediate office puts on a ground—that is, puts the main wire in communication with the earth without separating the main line—other stations may, by adjusting their armatures very closely, obtain what is being communicated upon the portion of the line intercepted by the ground. This is owing to the imperfect contact between the ground-wire and the earth, a part of the electric current passing by the ground-wire sufficient to work a delicate relay magnet.

ON MAGNETIC CALMS AND EARTH-CURRENTS.

By Charles V. Walker, Esq., F.R.S., F.R.A.S., &c.

II.

The author uses the word "calm" in a negative sense, "not storm," and states that very few notable earth-currents have attracted attention since the date of his original communication to the Royal Society, which was read on February 14, 1861.

Referring to that communication, he calls attention to the London, Tonbridge, and Dover-London lines of telegraph, making an angle of direction with each other of 149°, and by means of which a few groups of observations were made, from which the prevailing direction of earth-currents was determined to be approximately N.E. or S.W. He wished to multiply these observations and to modify them, which he was well able to do from the circumstance that the Dover-London telegraph wires enter his own private office at Tonbridge, where, by means of the necessary apparatus, he is able at any moment, when the wires are not occupied by telegrams, to obtain possession of the whole wire from end to end, Dover-London; or either section, London-Tonbridge or Dover-Tonbridge, the two former being the limiting lines, or those making the greatest available angle with each other, and the last, which is intermediate, being useful in confirmation of the observations made on the other two.

The telegraph needles have been rarely affected of late, the earth-currents, which form the subject of the present communication, being feeble. In order to their examination, it was therefore necessary to prepare a delicate galvanometer, which is properly connected with the telegraph wire, and furnished with the simplest possible apparatus for bringing it into action whenever occasion serves. It is within arm's length of the author when in his office. The pressing down of a spring allows any earth-current that may be present to enter the galvanometer; a brass plug, placed in holes 1, 2, and 3, gives possession of the whole line, or either of its sections. The needle is deflected on the side marked "up" or "down," according as the current collected is moving up or down the line; and in all the tables given in this communication the letters "u" or "d," placed beside the degrees of deflection, give the direction of the current in the above popular terms. The galvanometer, with its appliances, accompanies this communication, and is placed on the table as *in situ*, and will at a glance give an idea of the arrangement, of which also the author gives a plan.

A table is given of earth-currents collected at Tonbridge in October, 1861, on the lines in question, together with the Meteorological Register of the month. An analysis of these observations follows, included with which is an analysis of all observations of a like character that were made in the subsequent month of November.

A few cases are recorded in which the earth gave no sign of current. No stress is laid on this, because a closer investigation with more delicate instruments might have given positive results.

The contents of the table are divided into *Normal*, *Abnormal*, and *Exceptional*. Out of a total of 276 observations, 230 gave *normal* results, confirming the conclusion already arrived at, that the prevailing direction of earth-currents was approximately N.E. or S.W. Whether one or other of these directions prevailed more or less at different periods of the day did not appear, the observations not being sufficiently consecutive. Father Secchi's views of the relation between meteorological phenomena and magnetic variation are referred to. The author has reason to conceive that sunshine or cloud, heat or cold, influence the relative values of the current collected from different parts of the same district; in connection with which he refers to a group of night observations, which form part of the series made in October, and also to the want of consistency in the relation between two derived currents collected at the same time from different parts of the same plane. He gives a few extracts from the table, showing how very variable are the relations; for instance, 15° : 15°; 15° : 30°; 15° : 35°; 13° : 38°; 18° : 21°; and so on.

Professor Loomis's "Eighth Article" on the subject is referred to; and the correspondence between the results at which he arrives by other processes, and those to which Mr. Walker arrives by the methods herein described, are given.

In addition to the currents whose direction has been already noted, 42 cases occurred of currents which, for distinction sake, are called *abnormal*, and which were equally definite in character. They are found in the S.E. and N.W. quadrants; but the probable place in these quadrants could not be determined with any approach to accuracy from the lack of other lines of telegraph immediately at command. Four diagrams are given in illustration of the *normals* and *abnormals*.

The author mentions that the South-Eastern Railway Company have cordially entertained the proposition, to which he has previously referred, of the Astronomer Royal; and that he is now preparing to erect wires for Mr. Airy, terminating respectively near Dartford and Croydon, and which by combination will give an angle of 36° or 107°, the former, however, being without the range of normal direction. The consecutive observations to be made on these wires promise to be very instructive. The porcelain-ebonite insulator that will be used is described.

Among the 276 October-November observations, four cases occurred which are exceptional, and do not admit of similar discussion. Subsequent observations may explain these.

Next follows a survey of the N. and S. boundaries of a plane, the mean dimensions of which are 56 miles × 20 miles, bounded on the N. by the Thames, and on the S. by the Dover-Tonbridge line of railway. This was accomplished by aid of the earth-plates at Ramsgate and London, to the former of which access was had at Tonbridge, when required, by means of a switch at Ashford junction. A table is given of observations made during November and December, which show that the plane of the current is at least 20 miles wide, and the direction is consistent at either limit of the plane.

Tonbridge, being very nearly midway on a line joining London and Hastings, gave the opportunity of making observations on the whole, or on either half of a same line of country. The results collected in November and December are given in a table, and show a conformity in direction in the whole and in both halves, but a marked excess in value in the London-Tonbridge as compared with the Hastings-Tonbridge section. These differences are considered by the author as probably due to the different geological conditions of the country on either side of Tonbridge. Sections kindly furnished by Mr. Robert Hunt are referred to. These differences indicate the influence of local conditions, as the differences previously mentioned point at the interference of meteorological variations.

In order to satisfy himself that he was dealing with currents collected *boná fide* from the earth, and in no way from the atmosphere, arrangements were made with the clerks at Ashford to detach the observing wire from the earth there when required. A considerable number of observations were made during October, November,

and December, the results of which are tabulated. Whether the current, as shown by the galvanometer, was weak or strong, it in every instance entirely ceased when the wire at Ashford was detached from the earth and held insulated; so that no portion of the result was derived from any other source than the earth. These observations were made at all periods of the day and night, and in all weathers.

Powerful artificial currents were repeatedly made to flow into the earth by the earth-plates, in order to see whether any effects of polarization were produced; but the value of the earth-current, as observed before any such experiment, remained unchanged.

That the currents collected are in no way due to the electromotive power of the earth-plates themselves is shown by the absence of any sign of a tendency for one or other direction. They are independent in character and in value of all such influences. To prevent misconception, a list of the earth-connections used at the several stations that enter into the present investigation is given.

The author considers it may be premature to regard the subject as tolerably exhausted, as far as the means at his command are concerned; but at this moment he does not notice any other salient point within his reach. When the proposed special wires are ready for Mr. Airy, and consecutive observations are made and compared with the march of the magnetometers, the subject will be within the reach of the able hands of Mr. Airy; and we may be well assured that the various questions connected with it will be ably discussed by him.

The results comprehended in this and the previous communication are briefly summed up as follows:—

1st. That currents of electricity are at all times moving in definite directions in the earth.

2nd. That their direction is not determined by local causes.

3rd. That there is no apparent difference, except in degree, between the currents collected in times of great magnetic disturbance and those collected during the ordinary calm periods.

4th. That the prevailing directions of earth-currents, or the currents of most frequent occurrence, are approximately N.E. and S.W. respectively.

5th. That there is no marked difference in frequency, duration, or value between the N.E. and the S.W. currents.

6th. That (at least during calm periods) there are definite currents of less frequency from some place in the S.E. and N.W. quadrants respectively.

7th. That the direction of a current in one part of a plane on the earth's surface (at least as far as the S.E. district of England is concerned) coincides with the direction in another part of the plane; and if the direction changes in one part, it changes in all parts of the plane.

8th. That the relation in value between currents in a given part of the plane and currents in another given part is not constant, but is influenced by local meteorological conditions, and varies from time to time.

9th. That the value of the current of a given length, moving in a given line of direction, is not necessarily the same as of a current of the same length on the same line of direction produced, and that their relative value depends on the physical character of the earth interposed between the respective points of observation, and is tolerably constant.

10th. That the currents which have formed the basis of these investigations are derived currents from true and proper earth-currents, and neither in whole nor in any appreciable part have been collected from the atmosphere, nor are due either in whole or in any appreciable part to polarization imparted to earth-plates by the previous passage of earth-currents, or of powerful telegraphic currents; nor are they due to any electro-motive force in the earth-plates themselves.

11th. That the earth-currents in question (at least the powerful currents present at all times of great magnetic disturbance) exercise a *direct* action upon magnetometers, just as artificial currents confined to a wire exercise a direct action upon a magnet.

One of our poets, who has been rather slack of work lately, and whose eye has been rolling in a frenzy, to very little purpose, for the last fortnight, has furnished us with an idea on the subject of submarine telegraphy. He says, "it is like using the lightning conductor for a steel pen, and the ocean for an inkstand." He might have added, that the cliffs furnish the blotting-pad, the shore supplies the sand, and the whole world the sheet of paper to write upon.—*Punch.*

MR. G. G. NEWMAN'S METHOD FOR ASCERTAINING THE VELOCITY OF THE FLIGHT OF PROJECTILES.

The initial velocity of a projectile is the velocity at which it leaves the mouth of the gun. In experimenting with Mr. James Mackay's new gun at Crosby, near Liverpool, it was determined to find the time of flight from the gun to a point 120 feet in advance. Upon a first impression it will, no doubt, appear a difficult matter to accomplish this; but by a very simple contrivance Mr. Newman was enabled to obtain very accurate results. The apparatus employed is—

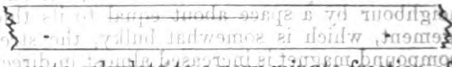
1st. A Bain's printing-machine, constructed to run rapidly, and with the train of clockwork carefully made, so as to ensure, as near as possible, an uniform quantity of prepared paper being passed in a given time. From eight to twelve inches of paper per second can be turned off, according to the speed at which the instrument is regulated to work. The "clip" carries two needles or pens insulated from each other, and pressing upon the prepared paper in the usual way.

2nd. A clock having a half-seconds pendulum, with an arrangement of battery contact springs to send momentary currents.

3rd. Batteries and gutta-percha wire as required.

The *modus operandi* is as follows:—The clock is placed in circuit with one of the insulated pens, so that at each beat of the pendulum a mark is put upon the prepared paper, showing the length paid off in each half second. The other pen indicates the time of flight, and is brought into use thus:—

A copper wire of 24 or 30 gauge is carried across the muzzle of the cannon, and passed backwards and forwards two or three times, so that it is certain to be ruptured. In the line of range, and 120 feet from the gun, two poles are erected, and copper wire, as before, stretched across zig-zag, so that there can be no possibility of the shot missing it. It will be seen, that whilst the wire across the mouth of the gun remains intact, the battery is upon short circuit; but immediately the gun is discharged the wire is broken, and the current then traverses the longer circuit, flowing through the crossing wires at 120 feet from the gun, and by the return wire to the insulated pen, marking a line upon the paper, which it continues to do until the shot, in its course, breaks the second wire stretched across its track. It will be obvious, therefore, that a diagram is obtained on the paper similar to this:—



which it is easy to calculate to a very minute fraction of a second.

By this method several advantages are gained—1st. Simplicity of action; 2nd. The instrument is self-registering; and 3rd. No time is lost by putting into operation, by the aid of electro-magnets or otherwise, any complicated mechanism.

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(*Continued from page 153.*)

8. *Step-by-step Letter-showing and Printing Instruments.*

(*a.*) *Letter-showing Instruments worked by Magneto-electric Currents.*—The dial, or step-by-step index, and printing instruments will next be described. The system of transmission on which they are founded differs essentially from that of the foregoing codes, inasmuch as the step-by-step instruments directly communicate the words, spelt in the usual letters; each of which, instead of being produced by a certain constant group or succession of currents, requires as many shocks or currents for its production as there are letters on the dial following that by which it was preceded. Several excellent instruments of this class were shown, which were worked by magneto-electric currents. They have all much in common, and are merely modifications of the first form invented by Professor Wheatstone in 1840.

The receiving apparatus in all cases consists of a step-by-step propelment, worked from an electro-magnet by alternate or reverse currents, and carrying a light index round a dial marked with the letters of the alphabet, accompanied sometimes by other symbols; each current moves the index forward one letter, and the index is moved from any given letter to any other by simply sending the required number of currents.

The transmitting apparatus in almost every case consists of an axial arm moved round a dial corresponding to the dial of the re-

ceiver, and so connected by gearing with the coils or armature of a magneto-electric system as to send one current through the line for every letter passed by the axial arm. These currents are alternately positive and negative. As all the instruments of this kind exhibited have so much in common, they will not here be described in all their details, but the peculiarities of each will be mentioned.

The points to be aimed at in instruments of this class are—first, to produce powerful and equal currents in the transmitter, depending for their intensity as little as possible on the skill of the operator; and, secondly, to construct for the receiver a very light and sensitive propelment which can be worked at high speeds by weak currents without risk of losing a step from sluggishness, or of allowing the index to overshoot the mark when the signals cease, as will frequently be the case with defective escapements, owing to the momentum of the moving parts.

In this class of instruments, as in all dial instruments, there are several serious difficulties to be overcome. The correct transmission of each letter depends on the correct reception of the foregoing letter, so that one error in the reception throws all the subsequent letters wrong, and necessarily entails an interruption and repetition of the message, whereas in the usual symbolic codes, such as the Morse, each signal is absolutely self-dependent, and the loss of a dot or dash is frequently of little or no consequence. The number of currents required for each signal is so large as greatly to increase the chance of failure in each signal.

On the other hand, any person who can read or write can, with these instruments, send and receive signals. No battery is required, and the instruments are, therefore, always ready for use. These great advantages have procured their extensive adoption for private and railway lines, police or fire stations, &c., especially in England and Germany. It may also be said that the difficulties described have been successfully overcome by the admirable workmanship and design of several of the instruments exhibited.

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit a simple and powerful magneto-electric dial instrument. In the transmitter the induction coil is wound longitudinally on a long soft-iron bar of an H section, the coils are protected outside by two brass strips, and the outer surface of alternate brass and iron is then turned so as to form a long compound cylinder. This cylinder is placed vertically between the poles of a set of ten flat horseshoe magnets laid horizontally one above the other, but each separated from its neighbour by a space about equal to its thickness. By this arrangement, which is somewhat bulky, the strength of the resulting compound magnet is increased almost in direct proportion to the number of plates added.

A toothed wheel on the axis of the radial sending arm, which is worked by hand direct, gears into a pinion on the axis of the cylinder, and causes it to make one semi-revolution for every letter on the sending dial. One end of the coil is in connection with the axis of the cylinder, and thence with earth, the other end by an insulated collar and friction-spring is connected with the line. It will be seen that in two positions the soft-iron bar must act as an armature common to all the magnets, but the opposite sides of the bar will be alternately opposite the north and south poles as the cylinder turns round. The magnetism in the bar will, therefore, be reversed at each half turn, and will induce a current in the surrounding coils; it should be remembered that the bar is not magnetized longitudinally, but transversely, and that the coils are wound up one side, and down the other side of the cylinder parallel to its axis. Each current is produced by a double action in the long armature, first, by the loss of polarity, consequent on its leaving the poles of the magnets; and, secondly, by the gain of the opposite polarity on its approach to the poles in a reversed position.*

If, however, the operator turns too quickly or too slowly, the currents will diminish in strength; in this and all similar instruments the danger is, that the operator will move the handle or axial arm too slowly both at starting and stopping. To remedy this, the letter-dial of the transmitter is surrounded by a metal ring with as many incisions or notches as there are divisions in the letter circle; the handle of the transmitter when stopped rests in one of these, and when turned must be slightly raised. These notches enable the operator to stop the handle by allowing it to fall sharply into the notch opposite the required letter. This device permits the operator to move his handle at full speed till the last current is sent, but nothing except practice will enable him to start at full speed—a necessary condition for accurate sending. Messrs. Siemens recommend 120 turns per minute as the proper speed for the sending arm.*

Any backward motion of the sending arm or coil cylinder would send currents in the very same manner as the forward motion, but the receiving index would move forward although the sending arm went back. It is, therefore, desirable to prevent all chance of such a backward motion, either from accident or want of skill on the part of the operator. This is very effectually done in Messrs. Siemens' instruments by three short levers hinged to the frame round the cylinder on pins parallel to its axis. When the cylinder turns in the right direction they rest lightly on the surface of the cylinder, held in that position by spiral springs. But these levers are just so long that, if the cylinder be turned the wrong way, they become jammed between its surface and their own hinges, stopping all further motion in the wrong direction.

The propelment of the receiving instrument is driven from an armature arranged as in Messrs. Siemens' polarized relay. This armature carries a fork, the two branches of which are of equal length; the axis of the index, bearing a small ratchet with thirteen teeth, lies between the branches of this fork. Two flexible spring pallets, one pressing against the top and the other against the bottom of this ratchet-wheel, are fixed to the two branches of the fork; these pallets work the propelment, as the fork is moved to and fro by the armature. Two screws adjust the play of the fork, and two other adjusting screws are placed at the back of the two spring pallets. Their function is very important; they are so adjusted that the spring cannot rise up so as to allow one or more teeth to pass until the pallet itself is moved a little forward; by this arrangement one pallet acts as a dead stop to the ratchet-wheel when the other pallet has just taken a tooth. With this escapement in proper adjustment it is absolutely impossible that the index should fly round or slip a tooth; it can only fail by want of strength in the received current to work the armature. The pressure of the spring on the inclined surfaces of the ratchet teeth adds, however, a little to the friction.

This instrument was tested with a resistance equal to that of 468 statute miles of No. 8 iron wire in circuit, and found to work perfectly. Similar instruments have for years been worked direct through a line of this length between St. Petersburg and Moscow. They have also been used for seven years in Bavaria for railway purposes, where there are usually six instruments in circuit, with the end stations twenty-five miles apart. Each instrument has a sending and receiving dial. When receiving, the currents do not pass through the induction coils; but in sending, the currents pass through the home dial, and show the operator that his signals are transmitted. There is a provision for making a home circuit to test the instrument, and also for setting the receiving dial to zero, or, as it is usually called, to the cross.

The transmitting arrangement is very powerful, and the receiver extremely good in design and execution, but both parts are far larger and heavier than the specimens exhibited by other English makers, and have consequently a somewhat clumsy appearance. The plan of starting and stopping the radial arm by hand for each successive letter is inferior to the continuous motions adopted by Professor Wheatstone, and subsequently by Mr. Wilde, but Messrs. Siemens consider their transmitting coils to be so powerful as entirely to obviate all danger from unequal speed in their revolution. They justly claim great simplicity and strength of construction, and state that above 700 of these instruments have been successfully at work for periods of from five to seven years.

W. T. Henley, H.M. (United Kingdom, 2,908), exhibits a magneto-electric dial instrument, in which the transmitting arrangement is novel. In this instrument the coils and permanent magnet are fixed, and the permanent magnet is never left without an armature extending between its two poles, although some portions of the armature are continually changed. The induction coils are wound on a soft-iron horseshoe, which is placed with its two poles in a vertical plane between two poles of a deep, powerful horseshoe magnet, lying in a horizontal plane. The polarity of the soft-iron horseshoe is reversed, and the required current induced, by connecting the poles of the soft-iron horseshoe alternately with the one and the other pole of the permanent magnet, by small soft-iron armatures. These armatures are placed in two parallel horizontal rings, the peripheries of which are on a level with the poles of the soft-iron horseshoe. There are thirteen armature pieces in each

* The alternate reverse currents induced by each half turn will, at a constant speed, be perfectly equal, for they are each produced by an exactly similar action.

* This does not mean that 120 letters per minute are to be sent.

ring, each separated by an air space, and the spaces of one ring are over the centres of the armatures of the other ring. The armatures are fastened on a brass wheel, and as this is turned round they pass in front of the poles of the permanent and temporary magnets, and make the following junctions in succession:—First, one of, say, the upper armatures connects the upper soft-iron pole with the permanent north pole, and one of the lower ring of armatures connects the lower soft-iron pole with the permanent south pole.

In this position two short armatures and the long soft-iron horseshoe, which has then its maximum polarity, form a nearly unbroken long armature, joining the two poles of the permanent magnet; as the brass wheel is turned the upper armature advances over the soft-iron pole, and the lower one recedes from it, until the upper armature forms a complete bridge between the two poles of the permanent magnet; while, on the other hand, a space between two armatures is opposite the lower soft-iron pole; in this position the soft-iron horseshoe has no polarity. As the motion continues the lower soft-iron pole is connected by a new armature piece with the permanent north pole, while the original upper armature piece passes over, so as to connect the upper soft-iron pole with the permanent south pole, and in this position the soft-iron horseshoe has a maximum polarity opposed to that produced by the first combination; the cycle is completed by the lower armature's forming a junction between the two permanent poles, leaving the soft-iron horseshoe again without polarity. During this sequence two opposite but equal currents are induced in the coils, and, nevertheless, the permanent magnet is always provided with a direct or indirect armature. The radial sending arm or handle is simply fixed on the brass wheel, so that no gearing is required.

The advantage claimed for this arrangement is that the permanent magnets retain their magnetism much longer than when the armature is torn away each time a current is induced. It may be said, on the other hand, that other arrangements—such, for instance, as that of Messrs. Siemens—have been in use for seven years at least, without any notable change in the magnetism of the permanent magnets.

Mr. Henley's instrument is moved direct by hand, but there is no notched wheel to enable the operator to stop suddenly, and no contrivance to prevent the handle from being moved back—it is consequently somewhat liable to fail in unskilful hands. There is a convenient arrangement by which either the line and home receiver, or the line alone, can be put out of circuit, for the purpose of regulating the agreement between the indicating and sending dials. In the receiving instrument the armature of the receiving electro-magnet is arranged as in Mr. Henley's other well-known instruments, and works a ratchet-wheel with twenty-six teeth by means of a fork. The writer is of opinion that it is just possible in one position of the fork for the index to turn without any corresponding motion of the armature.

A pair of these instruments worked correctly with a resistance equal to 185 miles of No. 8 iron wire in circuit.

(To be continued.)

THE PRACTICAL DEVELOPMENT OF THE SCIENCE OF ELECTRICITY.

On Monday, the 7th ult., an excellent paper was read to the members of the Galway Protestant Mutual Improvement Society, by Mr. Weir, telegraph clerk, on the above subject. The essayist illustrated his discourse by experiments, having a plate-glass electrical machine and Leyden jar, an electro-magnetic coil machine, and a magnetic electric machine in the room.

Mr. Weir commenced his essay by remarking that he had chosen the subject of electricity because of his practical acquaintance with it. Although parties entering the service of the Telegraph Company were not necessarily required to have a knowledge of the science, still it was to the advantage of the operator to be thoroughly conversant with the instruments in use, and the causes which led to such wonderful results. The most eminent electricians hesitated to give a decided opinion on the nature of the agent by which the phenomena termed electrical are produced. It has been considered probable that the effects to which have been given the names of heat, light, electricity, and magnetism result from the same agency in different conditions. Of the universality of electricity Professor Faraday states that there is as much employed to combine the gases in one drop of water, as would, if instantaneously liberated, cause a flash of lightning sufficient to rend the majestic oak, or destroy animal life. Electricity remains balanced and quiescent in bodies still excited, and some substances evince electrical properties more readily than others. About 1729 an important discovery, that of electrical conduction, was made by a Mr. Grey, of the Charter House, London. In attempting to render metallic substances attractive by friction, he found that although these substances were not excitable in the ordinary way, yet they might acquire an attractive power by placing them in communication with an electrified body. He found the attractive force capable of being conducted through metallic wire, but when cords of silk were substituted, the electric action disappeared. It was thus found that certain substances had the power of confining the communicated electricity upon other bodies, in which it could not, under the same circumstances, be so excited, while the non-electric substances allowed the electricity to pass off. Hence arose a distinct series of phenomena, dependent on what has since been termed electrical conduction, giving origin to a new classification of substances considered conductors of electricity.

In 1733, Du Hay, a French philosopher, discovered the existence of two kinds of electrical power, attraction and repulsion. Two equal and opposite powers are called into play, while these actions, when combined, condense or saturate each other, and thus neutralise the free action of either. Late experiments prove that the electric fluid is material, and is influenced to a certain extent by the laws of gravitation. There is another form of electrical charge, depending on the influence of excited bodies upon neutral conducting bodies, termed "electrical induction." Induction appears to be essential to the phenomena both of attraction and repulsion, and is attendant on both, perhaps preceding them. But neither attraction, nor change, has any dependance whatever on the solid contents of conducting bodies. In order to excite and collect sufficient electricity, electrical machines have been used. These instruments require an electric or substance capable of excitement; an exciting substance or rubber; and an insulated conductor, to receive and retain the electricity. We are said to be indebted to Otto Guericke, a burgomaster of Magdeburg, for the first idea of an instrument of this kind. Having mounted a globe of brimstone on an axis, he caused it to revolve against his hand and thereby obtained a rapid and powerful excitation. Various alterations have taken place, until the machines now in use were resolved on, in which the electric to be excited is either a hollow cylinder or a circular plate of glass. Positive electricity is generally obtained from the electric, and negative from the rubber. When we require positive alone, the conductor attached to the rubber for receiving the negative electricity is connected by a wire to the earth, and the negative is thus carried away. Conversely, when we require negative the positive conductor is connected with the earth, so that either electricity can be obtained at will. The lecturer then gave a lucid description of magneto-electricity, the essential principle of which consists in the converse operation of magnets, either permanent or temporarily produced, in the common electricity of non-magnetic bodies. The essayist then referred to the discoveries of Franklin, and mentioned the circumstance of Professor Richman, of St. Petersburg, losing his life while following up the successes of Franklin. In August, 1853, having erected an insulated rod from the top of his house and attached to it an electrometer, he stooped during a thunder-storm to examine the index, when a large globe of blueish fire struck him on the head, and he instantly expired. By experiments it has been found that the electricity of the atmosphere has a daily ebbing and flowing period, like the sea, being found to increase and decrease twice in the twenty-four hours. The first practical result of Franklin's discoveries was the lightning conductor. Sir Snow Harris improved upon it, and as an instance of the value of this invention it may be mentioned, that the Navy lost from £6,000 to £10,000 in property annually, and about 300 seamen by lightning; but since the system of lightning-conductors has been fully carried out, damage by lightning has entirely vanished from the records of the Navy. The difficulties which prevented the production of continuous electric light have very nearly been overcome. Its intensity seems eminently qualified for light-houses, railway signals, &c., and it will, ere long, supersede gas, oil, &c., for these purposes.

But perhaps the most wonderful application of electricity to the purposes of life is the facility it gives to persons separated by hundreds of miles to hold instant communication with each other, annihilating space as it were. The action of the electric telegraph is based upon the simple principle discovered by Professor Oersted, of Copenhagen, in 1819, that a magnetic needle, free to rotate about its centre, when brought near to a wire through which an electric current is passing, tends to place itself at right angles to that wire, the direction of its motion following a certain law; and secondly, that a piece of soft iron is rendered magnetic during the transmission of an electric current along a wire coiled spirally round it. A current, however, passed through a single wire, would not thus act upon a needle from a battery at any great distance, hence a large coil of wire is passed round each needle, and the consequence is that the power of the action is multiplied in proportion to the number of turns made. Professor Wheatstone and Mr. Cooke took out a patent together in 1837, for applying this discovery to the instrument that first sent intelligence from place to place with the speed of the lightning's flash. In 1846 Mr. Henley took out a patent for a magnetic electric apparatus, its action as a telegraph instrument being much the same as the electric telegraph, but the electricity is derived from magnetism, and the number of movements of the needle, which represent the letters of the alphabet, different. There are now numerous forms of instruments used in telegraphy, and numerous companies competing with each other. The needle instruments have, within the last few years, given way to others of more efficiency, such as the bell instrument, invented by Sir Charles Bright; the registering instrument by Morse, which marks the

characters representing the alphabet on a slip of paper; the typo-telegraph by Hughes, which actually prints the message; and the latest by Casselli, an Italian, by which the message transmitted and delivered will be a fac-simile of that written by the sender. But this system is not very general yet, and it is feared will not be very successful. The invention of the telegraph has been a source of employment from electrician, manufacturer, and contractor, down to the humblest labourer.

The paper was listened to with the utmost attention, and at the close, when Mr. Weir offered to give any of the members a "shock," much merriment was created when several of those present joined hands, and forming themselves into a ring, availed themselves of his kind offer. A powerful battery having been got into order, several were involuntary brought to their knees, lustily calling out *peccavi*, as they were completely at the mercy of the operator, being incapable of freeing themselves.

ATLANTIC TELEGRAPH COMPANY.

An extraordinary general meeting of the shareholders in the above company was held at the London Tavern, Bishopsgate-street, on Thursday last, for the purpose of receiving the report of the directors on a contract for manufacturing and laying the cable in the summer of 1865; for authorising, under the powers of the company's act of parliament, an increase of the company's unguaranteed capital, by the issue of new capital, to an amount not exceeding £150,000; to authorise or otherwise, as provided by the "Atlantic Telegraph Amendment Act, 1859," the issue from time to time, of bonds or mortgages for such amounts, as to the directors may seem expedient, not exceeding, on the whole, the sum of £100,000; and to do or perform any other thing which might be found expedient for carrying out the foregoing arrangements. The chairman of the company, the Right Hon. James Stuart Wortley, presided on the occasion, and was supported by a large attendance of the board of directors, as well as there being a large number of the proprietary present.

The SECRETARY having read the notice calling the meeting,

The CHAIRMAN proceeded to say that on the occasion of their last meeting, on the 16th inst., in answer to the appeal of the directors to the proprietors, for their confidence, they very kindly consented to an adjournment till that day, when he (the chairman) ventured to suppose that they should not have a less attendance on the present occasion than on the former, and he also told them that as they placed confidence in the board, they should be able, on the present occasion, to give them information of a most interesting character, in regard to the great work in which they were engaged. Since their last meeting, their progress had been such that they could not yet give all the information promised, and therefore premising that they did not give all that some of them might wish, he must still further appeal for a continuation of their confidence, in the mean time assuring them that they had considered every point in the contract which they had made, with a view to the interests of the general body of the proprietary. There were reasons which might prevent his giving all the details of the contract, but the amount of information which he should be able to present to them, would prove that the directors had not been negligent of the interests of the shareholders, but had done their best to conduct their business to a successful issue. He might say that this was the first of two great epochs in connection with their great enterprise, he might call it the laying of the first stone, and as such they had now but to ask their sanction to the contract for laying the cable. The next great epoch would be when, in about fifteen months hence, they should meet to celebrate its successful submersion. Since last they met, the documents to which he then referred, as being in the hands of the lawyers, had been completed, and he had now to inform them that they had contracted with the eminent firm of Glass, Elliot & Co. for the manufacture and laying of the cable. They were the persons whose cable was chosen by the eminent scientific committee to whom they had referred the choice of the cable best suited for their purpose; and they were the persons who had had most success in the laying of deep-sea cables; and although they might be somewhat startled at the amount which it would cost to lay a cable across the Atlantic, yet he was glad to be able to say that those gentlemen had shown a disposttion to treat the company with honour and liberality in relation thereto. He had led them to anticipate on the last occasion of their meeting that the sum for the cable would be a large one. It was hoped at one time that that which might have been chosen would have been cheaper than the last, but he regretted to say that such was not the case. That approved of was heavier in air, but not in water; its breaking strain was much greater than the former, as well as its contract strain; but what was worse was the fact that it was more expensive, as there was additional expense on account of the bulk; an advantage was gained in the strength of the strain, which was a matter of essential importance. The price which they will have to pay for the cable from England to America (including the laying) will be £700,000. It will occur to you that the paid up capital amounts only to £316,000; but the directors had been able to make arrangements by which payments will be made as the work proceeds, and if they are successful in laying the cable, they will be in a position to earn large profits, and then a bonus will be given to the contractors in unguaranteed shares of the old company amounting to £137,000, or nearly equal to 20 per cent. on the price of the cable. £350,000 will be paid in cash, £250,000 in guaranteed 8 per cent. shares, not to be paid at once, but as the work proceeds, and £100,000 in debentures, making in the whole the £700,000 as the price of the cable; and if successfully laid, there will be the bonus of £137,000 to be supplied—not in cash, but in shares and in portions—at the completion of every thirty days, as the cable should continue in working order. He would have been very glad to have been able to state every circumstance in connection with the matter; but he would appeal to them, that if the directors, by what they had done, had hitherto commanded their confidence, that they would not press them for further information, which might prove inconvenient. He might inform them that the delays incident to the legal profession had been got over, that the draft of the contract was then in the room, that it had been approved of by the solicitors on either side, and that, though not on parchment, it might be considered complete. Under those circumstances, it became necessary for them to provide for their liabilities; they had £316,000 in cash, having increased their resources as he explained at their last meeting; but as they had undertaken to provide £350,000 in cash, it became them to appeal to the proprietors and the public to put them in funds. At one time it was very difficult to get subscribers to the capital at all, but he was very glad to say that since the last failure public confidence in the undertaking had risen far higher; he might, indeed, instance his own case, for, although not a capitalist, so great was his confidence in its ultimate success, that he had gone on purchasing shares to the present time. It was the intention of the directors to issue £50,000 in 8 per cent shares to make up the deficiency in the £350,000, and if that should fail, which they could not anticipate, they had arranged that the manufacture of the cable should not be impeded, and, although he made an earnest appeal that they would assist the directors by taking up the shares, yet they had made such arrangements as would, in any case, secure the interests of the proprietors. He believed that he had fulfilled his task. He would now conclude by urging them to recommend the undertaking to their friends, to use their influence to interest them in the noble work which they had undertaken, a work which was unparalleled as one of the wonders of science, and which would be worthy to rank side by side with the seven wonders of the world; a work which was as a giant by the side of the Colossus of Rhodes, which was merely made to stride across a narrow stream, with his foot on the land on either side, whilst this would unite the interests and he hoped the hearts of two great bodies in the Old and New Worlds, and, by doing so, cement that friendship which should ever exist between the whole of England and America, and when that terrible cloud which now hangs over that unhappy and distracted country shall clear away, he trusted that that affection would revive towards this country which ought to exist between the mother country and her offspring, and which this noble and gigantic undertaking would aid in facilitating, for it will stride across the ocean, and thus connecting the two countries, will hold out the hand of friendship from one to the other, till that time should arrive when the lion and the lamb shall lie down together. (Hear.) He would now move "That this meeting, having heard the chairman's explanation of the contract entered into, by the board, with Messrs. Glass, Elliot, & Co., for the manufacture and laying down of the company's cable, hereby signifies its approval of the same."

Mr. JEWSBURY having seconded the motion, it was put to the meeting, and carried unanimously.

The CHAIRMAN said he had now to ask the proprietors to authorize the directors to issue additional capital, so that after the completion of the contract they may be able to pay over to the contractors paid up shares to the amount of £137,140. For this purpose he would move "That under the powers of the 'Atlantic Telegraph Company Amendment Act, 1859,' the ordinary unguaranteed capital of the Atlantic Telegraph Company be, and the same is hereby increased by the creation of 6,857 new shares of £20 per share, representing a par value of £137,140; and that the directors be, and they are hereby empowered, so soon as the contractors shall have successfully completed the submersion of the cable, in accordance with their contract and specification, to issue to the said contractors in manner provided in the contract, the said shares credited in the company's books as fully paid up shares."

The motion having been seconded by Captain HAMILTON, was put to the meeting, and carried unanimously.

The CHAIRMAN said that he had to trouble them with but one more resolution, and previous to reading it, he felt that he could not but congratulate the meeting on the fact, that the contractors so far evinced their confidence in the final success of the undertaking, as to be willing to take debentures in this company to the amount of £100,000 as cash. He would now move "That the directors be, and they are hereby authorized under the powers of the 'Atlantic Telegraph Amendment Act, 1859,' to issue from time to time, under the seal of the Atlantic Telegraph Company, bonds or mortgages on the stock and property of the company in such separate amounts, and bearing such annual interest and for such terms of years as they may deem expedient, and to renew and pay off the same from time to time as to them may appear desirable; provided, that the entire amount for which the said bonds are issued shall not at any time exceed in the aggregate the sum of £100,000."

Mr. EDWARD MOON having seconded the motion, it was submitted to the meeting, and carried unanimously.

The CHAIRMAN said that the business of the meeting had now been

brought to a termination, and he had to thank the proprietors for their attendance, whilst he trusted that they would do all in their power to advance the interests of their noble undertaking.

Dr Black said that, before they separated, they had a duty to perform to the chairman and the directors. But for the bravery and intelligence which had been exercised by those gentlemen, the company would not have been in the excellent position it then was, for it had required a great deal of bravery and intelligence on their part to combat with all with which they had had to contend, and to enable them to present the meeting with such a statement as they had heard. He had, therefore, the greatest pleasure in moving, "That the most cordial thanks of this meeting be presented to the chairman and the board of directors, for the very able manner in which they had conducted the affairs of this company, and to the chairman for presiding on this occasion."

Mr. Hack seconded the resolution, which was put to the meeting and carried unanimously.

The Chairman, in reply, said that he had to return thanks on behalf of the directors and himself for the compliment they had been pleased to pay them. It was the first time that he had ever had to return thanks, not merely for presiding at a meeting, but for the course he and his colleagues had taken to carry on the affairs of the company. In thanking them for their sense of approbation, he might be allowed to say, that though he might have persevered in the cause under circumstances of great difficulty, yet he could not have done anything if he had not been assisted by such commercial men as constituted the board. Whilst it were almost invidious to mention names where all had rendered able assistance, he felt that he might notice those of their excellent vice-chairman (Captain Hamilton) and Mr. Cyrus Field, who, within the last week or ten days, had brought parties together by which they had been able to conclude some of their great affairs. In conclusion, he begged to thank them on behalf of his colleagues and himself for the mark of their approval now presented to them.

CORRESPONDENCE.

TELEGRAPHIC FAC-SIMILES.

To the Editor of the Telegraphic Journal.

Sir,—The article complained of for its inaccuracy as to date, and in other respects, by your correspondent "One who took part in the Experiments," was copied from a scientific work. The date should have been 1851, as your correspondent states. As to the other matters complained of, not being present at the experiments, I feel thankful to your correspondent for the correction. That the invention was in existence in 1848, I have only to say that Mr. Alexander Bain fully described the instrument to me long before that date, and I believe that he was the true inventor of that mode of transmission; and in 1858 he related to me the history of the invention, and the manner in which he was deprived of the credit or the advantages which might accrue therefrom.

Veritas.

FAULTS IN INSULATION.

To the Editor of the Telegraphic Journal.

Sir,—I have referred to the pages of Mr. Culley's work in which the above subject is treated, and to which the attention of your correspondent "K. H." has been directed. I confess that I cannot exactly comprehend how the effect of a fault on signals can be greater when nearest the sending station, provided the resistance of the leakage remains the same. Suppose a wire, 180 miles in length, is charged with a battery of 24 cells, which charge has to overcome a resistance at a fault within 20 miles of its distant end, equal to another twenty miles of the same wire, we should then have a resistance, exclusive of the instruments and batteries, of 200 miles against the working current, or a loss equal to the electromotive force of 26 cells of the battery. On the other hand, let the wire be charged at the end nearest the fault with the same battery-power, the loss still would not exceed the force represented by the 26 cells, unless the fault be increased by its proximity to the battery.—Yours, &c.,

John Melford.

Dublin.

PERSIAN GULF TELEGRAPH.

To the Editor of the Telegraphic Journal.

Sir,—It is now, I believe, nearly two years since I have read, in some of the papers, of an India-rubber manufactured cable having been sent by the Indian Government to the Persian Gulf. I have no recollection of having ever read of its being laid, or what has become of it. As I have great confidence in the applicability of india-rubber for submarine telegraph purposes, I should be exceedingly glad to learn something about the said cable, and with that view, I must ask you kindly to insert this letter, hoping that it will elicit the required information from one of your Indian subscribers.—I remain, &c.,

P. Waithman.

TELEGRAPHIC NEWS.

Mr. S. Statham.—We deeply regret to have to announce the demise, in the fifty-ninth year of his age, of the above much respected gentleman, for many years the manager of the Gutta Percha Company, Wharf-road, City-road. Mr. Statham had been suffering some time from severe illness. We believe that it was Mr. Statham who first suggested gutta percha as an insulator for subterranean and submarine telegraph wires. The first wire was covered for Mr. Ricardo, we believe, in 1845, upon which we had an opportunity of making several electrical experiments at the time.

Telegraph Clerks' Provident Fund.—In our last it was stated that the British and Irish Magnetic Telegraph Company had given a donation of £15 15s., and that the Messrs Rothschild had subscribed £10 10s to the above fund. The esteemed secretary desires us to correct the foregoing announcement, and to state that the British and Irish Magnetic Company will allow *an annual subscription* of £15 15s., and that Baron L. de Rothschild has given *a donation* of £10 to the fund.

Electric and International Telegraph Company.—The Lowestoft cable laid in 1862, and which had been out of repair during the winter, was successfully repaired on Monday, the 28th ult., by Mr. C. Varley, electrician, and Mr. J. Blacklock, submarine engineer, of the company. The fault was found to be in 30 to 32 fathoms, and the repair was executed during a very severe storm.

Telegraphy in the Isthmus of Suez.—The whole route of the Isthmus of Suez has been placed in communication by the telegraph. The principal stations are Port-Saïd and Suez, the two extremities, and Ismailia, the centre. Thence the wires pass Tell-el-Kebin and joining Zagazig, which city is in communication with all Egypt, and consequently with Alexandria, correspondence may be carried on with all the European capitals.

Gisborne's Electric Steering Apparatus.—We have on more than one occasion referred to this extremely ingenious and efficient contrivance. Its employment on board Her Majesty's iron-clad frigate Royal Oak is thus described by the commander, in a letter to the patentee:—"Corfu, March 12, 1864.—Sir,—With regard to your 'Electric Steering Signals', I cannot say enough in their favour. In foggy weather, and at night time, they are *most valuable*, especially when in the midst of shipping, or bringing up in a crowded anchorage, when it is necessary to conn the ship from as far forward as possible. Your signals being placed on the fore-bridge, one is nearer the object in view, and directions can be given the helmsman instantaneously, and without hailing, or chance of misinterpretation. Knowing their value I should be very sorry to be without them, and I do hope they will be universally adopted throughout the navy."

Sale of the Brett Collection.—The late Mr. J. W. Brett, who was designated by Professor Morse, "the father of submarine telegraphy," was also an artist of considerable attainments, besides being a man of varied and refined taste, united with that indefatigable enthusiasm of research without which the collector, however fortified by wealth, fails to realise such comprehensive dream of rare possessions. Taken as a whole, the assemblage of pictures and other objects of art, privately exhibited during the past few days, at the residence in Hanover-square, is one of the best representative gatherings recently brought under an auctioneer's hammer. The sale, at Messrs. Christie and Mansons, will commence on the 5th instant, and will extend over ten days, previously to which the collection will again be on view for a short period. Several of the paintings are well known, as, for instance, the noble "Entombment," painted by Titian for Philip the Second; the portrait of a little Spanish girl, by Velasquez; the "Adoration of the Magi," which, when in possession of the late Lord Northwick, was attributed to Van Eyck, but which is now, with greater likelihood, assumed to be the work of Hemmelinck; and the fine "Boar Hunt," by Rubens and Snyders, a picture which would be a valuable addition to our national art-treasures, so deficient in examples of the last-named painter, albeit undoubtedly rich in the labours of the great Peter Paul. It would be impossible within our present limits to enumerate all the works worthy notice in this collection, ranging, as they do, over the widest fields of art, and including productions of every known hand, from Fra Angelico to Vandyke, and from Raffaelle to Greuze. We cannot, however, pass some of the most salient features without expressed recognition. There is a remarkable tempera painting, by Raffaelle, from Cardinal Rossi's collection, representing "Christ bearing the Cross," and so marvellously fresh in the light colours, which give it a peculiar effect of space, as to suggest a modern resemblance to the works of the late Mr. Dyce. Curiously enough, there is, in an adjoining room, one of this lamented painter's happiest efforts, a "Virgin and Child," which might, on its part, recall the spirit and manner of Raffaelle. The collection is notably rich in the richest of Stothard's works; and it boasts many fine examples of the great Sir Joshua, characterised by his utmost grace of expression. Among the drawings are some of Mr. Brett's own execution, showing much versatility, without loss of power in the changes of style and subject. The miscellaneous articles of the collection comprise a large array of carvings, bronzes, porcelain, Limoges enamels, goldsmith's work from the sixteenth century downwards, gems, engravings, medals, and coins. Careful and effective photographs of the principal objects have been taken by Mr. Ayling, of Oxford-street, and from his pictures an illustrated catalogue has been prepared.

The Electric and International Dramatic Club.—This society gave a benefit performance at the Cabinet Theatre, King's-cross, on March 16th. The pieces selected for the occasion were "Raising the Wind," "Furnished Apartments," and "Love in Humble Life," interspersed with an Ethiopian entertainment, and the talented performance of Master Montague, the "Infant Nonpareil." In "Raising the Wind" the character of "Sam" was sustained by Mr. James Cook with his usual marked ability, and obtained for him hearty applause; nor must we omit to notice the very able manner in which Mr. Garrard played the arduous part of "Jeremy Diddler." Messrs. John Young, Tripe, and Gilbert, most effectively supported the various *rôles* entrusted to their representation, while the minor parts were played with commendable care by Messrs. Simmonds, Hester, and Barker. This piece was a decided success, and highly relished by the audience. In "Furnished Apartments" Messrs. Garrard and Tripe acquitted themselves with their wonted ability, whilst Messrs. Boxall, Brandon, and Simmonds also performed their parts to general satisfaction. The Ethiopian entertainment caused much merriment. It must be stated that these gentlemen came forward at the eleventh hour to assist in the work of charity and goodwill, and the necessarily few rehearsals would amply excuse any slight hitches that were apparent. We cannot, however, omit to record the due meed of praise to Messrs. Bright, Crawley, and Atkins. The concluding drama, "Love in Humble Life," was the crowning piece of the evening. Mr. Perry, as "Rouslaus," the soldier, was very effective, and Mr. James Cook, as "Carlitz," was especially worthy of notice, exhibiting, as he did, a most judicious and admirable combination of humour and pathos; and now, *place aux dames*, the artistic and pleasing manner of Miss H. Gower, as "Christine," added in no small degree to the beauty and success of the piece. The theatre was crowded by a select and attentive audience. We are glad to be able to announce that the performance realised a handsome sum for the gentleman for whose benefit it was given, he being one of the club's most active members, and who has been laid up for some weeks with a severe and distressing illness. We understand that the club intends giving its usual quarterly entertainment shortly.—Mr. R. Boxall, an old and valued member of the club, has succeeded Mr. J. Young, who, on his retirement as secretary, received a cordial vote of thanks for past services, and a special invitation to continue in active membership, which request was acceded to.

Galvanization of Iron.—The Society for the Encouragement of Art in France has given a prize of 10,000f. to M. Sorel, the inventor of the process for galvanising iron.

Communication with Italy.—The telegraph has been established, and is now in operation, between Lyons and Turin, by Mount Geneva. One of the advantages of this new line of communication has been a reduction from one franc to fifty cents. for messages.

The Levant Submarine Telegraph Company.—It is on record that some of our most important submarine lines have been impaired, or completely destroyed by lightning. Numerous contrivances have been suggested for the protection of submarine cables from the effects of lightning, hence we have great pleasure in inserting the following important testimony to the efficiency of a lightning-conductor supplied to the above company by Messrs. Siemens, Halske & Co.:—"Chibs Station, Nov. 20, 1863.—Gentlemen,—It is with great pleasure I inform you that, owing to your excellent plate lightning conductors, the cables belonging to this company have for the third time been saved from destruction. A few days ago a heavy thunderstorm passed over the island of Metelin, destroying eight poles completely, and the electric fluid of which passed along the line-wire into the cable-box, where it was luckily arrested from entering into the cable by fusion which had taken place between the upper and lower plates; the latter was well connected to earth. I had some difficulty to separate them. Twice before the cables landed in the Bay of Scala Nova were saved by the same means. Should you think fit to make use of this statement you are welcome to it, and believe me, gentlemen, yours very truly, W. Buffles, Electrician and General Manager."

The Bombay Line of Telegraph.—The *Ceylon Times* thus refers to the casualties which are continually befalling this telegraph:—"We wonder when the Indian telegraph authorities will turn their serious attention to the frequent interruptions on the Bombay line. Into such a chronic state of disorder have matters fallen along that line of wire that the arrival at Galle of the steamer from China is an unfailing signal for an interruption to telegraphic communication. One message goes through well enough, but the second invariably halts at some intermediate station on the southern continent, generally for a week at a time, until, in fact, the opium speculators concerned in the trick have 'made their game.' It is at all times an ungracious, and often a reprehensible act, to impute motives, but in the present case we are spared the unwelcome task. It might, indeed, be a somewhat dangerous pastime for an editor to indulge in, to charge the servants of the Indian Telegraph Department with corrupt practices. We might not escape so cheaply as a judge who taxes a jury with a similar 'itching of the palm.' But in the case under notice there is no occasion to seek for any motive whatever. The practices of certain parties along that line have been so completely unmasked, and punished by a Bombay magistrate, that the recurrence of these tricks only serves to show that there must be enormous profits made through them—sufficiently so to induce heavy temptation being cast in the way of underpaid native officials. Surely it is worth while for the chief of the department to see to this; the annoyance and loss to the commercial public are more than that functionary can well imagine."

Jersey and Piron Telegraph Cable.—This submarine line, which has been out of repair since November, 1863, was put into working condition in January last.

Merit Rewarded.—By a decree of the 5th of January, M. Ceillier, superintendent of the telegraph service in the province of Constantine, France, was named "Chevalier de la Legion d'Honneur."

Atlantic Telegraph Company.—The tender of Messrs. Glass, Elliot, & Co., to manufacture and submerge the new Atlantic cable for £700,000, has been accepted, and the work now in progress will be proceeded with under able superintendence.

The Indo-European Telegraph.—The following particulars of the laying of this important line of communication are contained in the *Times of India*, of the 29th February:—"The latest news we have from the Gulf are to the 6th February, on which day the Semiramis left for Bombay with the Kirkham in tow, all the submarine cable which the latter vessel brought out from England having been laid down along the Mekran coast, from Ras Guadur westward towards the entrance of the Persian Gulf. Perhaps many of our readers may not be aware that since April last Guadur has been in telegraphic communication with Kurrachee, through a land line of about two hundred and fifty miles. Guadur is a small fishing town on the southern shore of Beloochistan, which is known as the Mekran coast. At one time it was intended to carry a land line all along the Mekran coast, but various considerations have determined Government on preferring submarine communication, which at present will begin at the extremity of the land line at Guadur. Guadur, therefore, was the appointed rendezvous for the vessels containing the cable and the engineering and electrical staff. By the 30th ult. they were all collected there, the Bombay marine steamers Coromandel, Zenobia, Semiramis, Victoria, and Clyde, and the sailing ships Kirkham and Marian Moore. The Coromandel's duty was to act as pioneer to the vessel paying out the cable, by taking soundings, and so keeping her as much as possible in a uniform depth of water; the Zenobia towed the Kirkham, on board of which was the first section of the cable, and the Semiramis brought on the Marian Moore, with the second section. The Victoria assists in the pioneering, and is ready as an auxiliary towing power, in case of any accident to either of the others. The gunboat Clyde, by her light draught of water, is well adapted for landing the cable where it is necessary to have a shore station. The first thing to be done was to land the shore end from Kirkham, at Guadur, and this was most successfully accomplished on Wednesday and Thursday, the 3rd and 4th inst. Owing to the shallow water in the western bay at Guadur, the large ship could only get within about two and a-half or three miles from the shore but the gunboat could go much further in, and when the water became too shallow even for her, the large paddle-box boats of the Zenobia could convey the end of the cable up to the beach. Accordingly as much cable as was required to reach from the anchorage of the Kirkham to the nearest point to the shore at which the gunboat could anchor was coiled down on the gunboat's deck, the portion required to reach on to the telegraph buildings having been previously coiled down in the paddle-box boats. With these in tow the gunboat steamed towards the shore, paying out the cable as she went; and when all on board of her was finished the boats paid out till they reached the shore, when the end was quickly buried in a trench leading up to the offices. This done, there was direct communication between the end of the cable on board the Kirkham and the end in the Guadur office, while by the land line the connection was continued on to Kurrachee and Bombay. Of course, as soon as Colonel Stewart and Sir Charles Bright went on board the Kirkham, after completing the shore work, they proceeded to test the efficiency of the cable, and as soon as a message came from Kurrachee it was sent through to them—curious to say, it referred to a domestic occurrence of personal interest to the latter gentleman. The end of the cable having been thus safely landed, the laying down of the rest of the section to Mussendom, at the entrance of the Persian Gulf, had next to be proceeded with, and the same evening the vessels started—the Coromandel going before to show the way, and the Kirkham, in tow of the Zenobia, following at a little distance paying out the cable. This was on Thursday evening. On Saturday morning the Kirkham had paid out all she had on board, and the Marian Moore was brought up by the Semiramis to have the end of the Kirkham's section of cable spliced on to her's, after which the Semiramis took the empty Kirkham in tow, and went to Muscat for coals to bring her down to Bombay. The weather hitherto has been most propitious for the work, so that the cable has been laid at the rate of between four and five knots an hour, and without a single accident. The entire management is most excellent. Lieut.-Colonel Stewart is a marvel of energy, activity, sagacity, and a thorough scientific knowledge of all the details of the deeply important work which has been entrusted to his management. What one sees of him now makes it easy to believe how completely the wonderful regularity with which Lord Clyde's army was kept in communication with the seat of Government during the mutinies, was dependent on his personal exertions. Sir Charles Bright brings every tittle of the experience he has gained in many similar operations to bear on this, the most important of them all, and he is ably seconded by his numerous staff. None but those who have actually witnessed the operation can imagine the immense amount of labour which is required in laying down a submarine cable, especially in a part of the world where every necessary of life has to be carried to the stations at which employés are to be left."

MISCELLANEA.

Apt Phraseology.—In the Irish language the electric telegraph is called *Sgeol abada boita*, the literal translation of which is "news upon stilts."

The Atlantic Telegraph.—"But this little spark which we are now sending under the ocean—this flash of lightning which passes from shore to shore—this fire which burns there inextinguishably—may truly be considered, if it were not too sacred an expression to use, to be the bond of that love and of that charity between the two nations, of which the sacred text says, that 'many waters shall not extinguish it, and many floods shall not overwhelm it.' Yes, I have no hesitation in saying that it is time for the American eagle to let go those lightnings which it is represented as grasping in its talons, and let them drop into the ocean, and they will cross it safely and come to us, not accompanied with any manner of thunder, but spreading the words of softness and of peace. It is, therefore, a matter of great pride that this island has been chosen by Divine Providence as the means of this most happy communication—of this binding of nations and worlds in bonds which we may trust will be of irrevocable and indissoluble peace. It is no small pride for it to have seen the most splendidly successful application of the most magnificent of those gifts of science and genius which God has given for a blessing and an honour to this age; that after so many years of sorrow and of suffering, of calamities of every sort, of famine and disease, this glory should have been given as a recompense to this noble land."—*Cardinal Wiseman.*

The Smallest Magnet and Electro-Magnet.—Sir Isaac Newton possessed a steel magnet weighing only three grains, and which supported a weight of 746 grains, or nearly 250 times its own weight. This curiosity was set in a ring which the philosopher wore upon his finger. But the attractive power of this permanent magnet is small when compared with that exhibited by an electro-magnet constructed by Dr. Joule for his "Experiments Demonstrating a Limit to the Magnetizability of Iron" *Phil. Mag.*, Vol. II. No. 13). This was made of a piece of iron wire one-fourth of an inch long and one-twenty-fifth of an inch in diameter, bent into a semicircle, and wound with three turns of uninsulated copper wire one-fortieth of an inch in diameter. It weighed only half a grain, and carried in one instance 1,417 grains of iron, or 2,834 times its own weight. To his description of this wonderful little magnet, Dr. Joule adds:—"I subsequently had the pleasure of presenting Dr. Roget with a still more minute electro-magnet, which has sustained about 3,500 times its weight of iron."

Bonelli's Telegraph.—"M. Bonelli, the ingenious inventor of a first autographic telegraph, and of the electric weaving-loom—one of the marvels of human genius—has been endeavouring for some months past to introduce into France a system of electric transmission, as curious as it is rapid and economical. The dispatch is set up in printing type, and placed on a little carriage, which is made to pass beneath a comb with five teeth, which are in communication with the five aeriel wires of the line, at the extremity of which these same wires are joined to the five teeth of a second comb, under which passes a chemically prepared paper, carried along on a little carriage similar to the one at the other end on which the printing type is placed. If, under this arrangement, the electrical circuit of a battery composed of a sufficient number of elements, and distributed in a certain order, be completed, then at the same time as the first comb is passing over the printing type at the one end, the second comb at the other end will trace the dispatch on the prepared paper in beautiful Roman letters, and with so great a rapidity that it may be expected that 500 messages of 20 words each will be transmitted per hour. Scarcely were the first machines of the Chevalier Bonelli set up in a room in the office of the Central Administration, and even before any trial was made, when not we, but competent men well known to Monsieur du Moncel himself, in an article quoted by the *Presse Scientifique des Deux Mondes*, thus closes a critique more than severe:—'The telegraph of Monsieur Bonelli is then nothing more than an ingenious apparatus for a room, applicable at the most on very short and perfectly insulated lines, and most probably incapable of being worked over long lines under circumstances such as have hitherto existed.' We, on the contrary, courageously defend Monsieur Bonelli, as we defended the Abbé Caselli, whom the journal of Monsieur Barrel also attacked. Now on Sunday last we saw Bonelli's telegraph at work on the line between Paris and Boulogne, which is by no means a short one, being 272 kilometres, and which is so badly insulated that the wires are very often powerless to work the Morse instrument. Although the five wires were only at the disposal of Monsieur Bonelli for about half an hour, which was hardly a sufficient time to get them in working order, we were enabled from the first experiment to receive several dispatches perfectly printed, and with that truly incredible rapidity which constitutes the great hope of cheap telegraphy. Let Monsieur Bonelli be permitted to work the five wires between Paris and Lyons, or even from Paris to Marseilles, and his success will not be the less striking. We confine ourselves at present to these few remarks, because we intend shortly to give a complete description of this marvellous system of typo-telegraphy. Let us conclude by calling on Monsieur Barrel to retract, and to acknowledge that he has for twenty years past seen us in the foremost rank of progress, proclaiming loudly the genius of invention, sinning rather by an excess of boldness and good-will than by an excess of timidity and indifference."—*Les Mondes.*

The French National Telegraph.—The following figures show the progress in the number of messages sent and revenue from 1851 to 1862:—

Year.	No. of Messages.	Receipts. Francs.	Cents.
1851	9,014	76,722	60
1852	48,105	542,891	58
1853	142,061	1,511,901	57
1854	236,018	2,064,983	71
1855	254,532	2,487,159	21
1856	360,299	5,191,102	4
1857	413,616	3,333,695	74
1858	463,973	3,516,633	70
1859	598,701	4,022,799	78
1860	711,652	4,188,065	26
1861	903,610	4,919,737	96
1862	1,521,100	5,316,000	96

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine mixed, first and second qualities.....	2/3 to 2/6 per lb.
Good re-boiled.............................	1/7 to 1/10 ,,

India Rubber.

Para, first quality	1/10 to 1/11 ,,
second ,, ...	1/7 to 1/8 ,,
third Negro-head	1/2 to 1/3 ,,
Java and Penang	1/4 to 1/5 ,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	100 to 103	—
100	Submarine Telegraph, scrip. .	all	48 to 53 x d	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	1 dis. to par	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	$1\frac{1}{2}$ to 2	—

TO CORRESPONDENTS.

The Communications of Dividend and A Deluded Shareholder are unavoidably postponed.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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Four lines and under (single column)...........	0	3	0

THE TELEGRAPHIC JOURNAL.

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LIGHTNING DISCHARGERS.

THE evil, and frequently fatal, effects of lightning on subterranean and submarine telegraph lines have led to the introduction of various contrivances for protecting the insulating material from injury and destruction. It is strongly suspected that the absence of such precaution, or the employment of imperfect dischargers, have contributed to a far greater extent than at first supposed to mar the success of our submarine lines. In the report of the Government committee the subject is not even referred to, although several instances are given in the evidence of the injurious and fatal effects of lightning on long lines of underground and submarine telegraphs, and various methods suggested for their protection. It is known that the Malta and Corfu and the Toulon and Algiers cables were destroyed during heavy thunderstorms. In glancing over the register of signals which passed through the first Atlantic cable in 1858, we find that on the 13th of August the signals are represented as "perfect," on the 20th as "splendid," and that "first-rate signals were received at Newfoundland from Valencia on the same day." On the 21st the signals are stated to be "beautiful," on the 22nd "good," on the 25th "splendid sending." On the 26th we are informed that there was a heavy storm and lightning in Newfoundland, and that, in consequence of the lightning being so strong, the end of "the cable was put to earth for protection." During the remaining days of the cable's existence the current is reported as weak and variable, which evidently rendered it very difficult to carry on any communication. The gradual deterioration and the final collapse of the cable are results which might have been expected from its having been traversed by a flash of lightning, or by excessively strong currents. The evidence given before the Government committee on the subject is highly instructive, and deserves the most serious consideration, especially at a time when it is in contemplation to submerge several extensive lines of deep-sea telegraphs. Mr. Latimer Clark, in reply to the questions addressed to him, states:—

In shoal water there are numerous causes which need scarcely be mentioned—anchorage, and, above all things, rocks; and I may also, perhaps, speak of rust as being a very common cause of injury; but in deep water the chief injury, I should apprehend, would be from lightning, and from a phenomenon which constantly occurs in gutta-percha wires, which I believe now is confined to them. It is this that, after lengthened use, especially after great battery power has been long sent through them, a small fault will sometimes display itself without any apparent cause. That will not interfere with working at first; but, after a time, the currents will gradually enlarge the fault, and make it become so great as to stop all working. I never yet satisfactorily, to my own mind, accounted for those faults, and therefore they remain, in my mind, a sort of shadow on submarine cables. I should be very glad if any explanation of them could be given. At present, as far as I have seen, gutta-percha is liable to have these small faults, commencing in it without any very apparent cause, and gradually enlarge themselves till they stop the working. One result has been that we have had to lift cables, in shallow water, to cut out those faults, and replace them, which we have done without learning much from them, unless they have been made, as they have in very many cases, by lightning.

Have you seen any cases of injury from lightning to submarine cables?—Injuries from lightning are very frequent both in submarine cables and in underground wires, wherever they are in connexion with overground wires. I think the best remedy for this in submarine cables is to lay a considerable length of the telegraph near the shore in an iron-coated cable, and to place lightning-conductors both at the margin of the sea where the submarine cable commences, and also at the end where the land cable commences. In that way some resistance is opposed to the lightning travelling on and causing injury to those parts which are beneath the water; the large injuries will probably occur near the sea. I have also designed a peculiar lightning-conductor, which I believe to be extremely well adapted for burying in out-of-the-way exposed places.

What is the form of that lightning-conductor?—It is made by taking a slab of slate, drilling holes through it, and placing it upon a planed slab of iron; pins of brass are then thrust loosely through those holes, so as to rest on the iron; melted lead is poured over it, so as to cement the holes solid; this compound of a cake of slate, with these points passing through it and resting on the iron, is then lifted up, and a piece of ordinary silk or oiled silk is placed between the slate, the points, and the slab of iron, and there supported. The conducting wire is placed in connection with this slab with the points, so that any lightning would burst through the oiled silk, and make its exit to the earth. The whole of this apparatus is enclosed in a cast-iron box, luted in with pitch, and some quicklime is enclosed with it, so that the atmosphere is always kept dry within.

Have you tried that lightning-conductor?—Not practically, only experimentally. In its general form it corresponds with the lightning-conductor which has been used commonly for many years past, the peculiarity consisting in the method of adjusting the points and the use of quicklime.

Mr. Saward, the secretary to the Atlantic Telegraph Company, gives his experience with respect to the effect of lightning on subterranean lines as follows:—

Have you observed, while you were connected with the British Telegraph Company, any underground wires destroyed by lightning?—I have had specimens brought to me, which were said to have been injured by lightning.

Did you notice any peculiarity about those specimens to lead you to see how the lightning had struck the wires?—Not how it had struck them, but how it affected the gutta-percha.

Was it at all similar to the appearance exhibited by the specimens which have been produced?—No. The gutta-percha in the cases which I have seen was split open, but not riddled like the specimens I have seen on the table. I had never seen one affected that way by lightning until I saw it here. In those that I have seen the lightning seemed to have flashed open the gutta-percha altogether.

Mr. Cromwell F. Varley, from his lengthened experience in the supervision of the extensive lines of the Electric and International Telegraph Company, furnishes us with the most important information as contained in his evidence as to the injurious and destructive effect of lightning on the company's lines—aerial, subterranean, and submarine—which proves the vast importance of having efficient dischargers for the protection of the valuable property jeopardized by lightning, and more especially in the case of deep-sea cables, which cannot be raised and repaired when injured, as evidenced in the unsuccessful efforts made to recover the Toulon and Algiers line:—

You have doubtless observed the effects of lightning on underground and other wires—what has been the result of your observations?—Wherever underground wires are used in connection with forming part of overground circuits, they are sure to be destroyed by lightning in time. In the case of a line in which there are many wires, the lightning strikes the top wire, and then in numerous sparks strikes all the other wires. It then, to a great extent, makes its escape at the poles, splitting them, and sometimes knocking out pieces as if they had been hit by a pickaxe; at other times splintering the poles, and throwing the splinters to a distance of even 200 yards; and, generally speaking, a portion of the current traverses the line to the distant end, burning up such instruments as it meets in its way; or should it meet with a tunnel in which there is a gutta-percha covered wire used, or should the wires go underground covered with gutta-percha, it almost invariably punctures them. I cut out, two years ago, a fault from the Kilsby tunnel, in which there was a minute hole right through the gutta-percha, and through Mr. Edwin Clark's covering of tarred and sanded tape. The material was charred, and an electric connection established between the conductor and the roofing of zinc which covered the grooved boarding in which the gutta-percha line was located. That made a very bad fault; and upon removing the tape there was a hole, about the twentieth of an inch in diameter, through the gutta-percha, presenting all the appearance of having been burnt by lightning. It did not present the appearance of that piece of wire which lies upon the table. That I attribute chiefly to the fact that the wire was covered tightly round with tape, which held the gutta-percha in position to prevent it from bulging out by the explosion.

You said that you anticipated that any subterranean or submarine wire connected with a sub-aerial wire would be subject to destruction by lightning. Do you think that no arrangement can be made at the junction of the two wires, by lightning-conductors or otherwise, to prevent that destruc-

tion ?—In 1847 I made a lightning-conductor, in which the wires are brought very close together in an exhausted chamber; and upon testing those, I found that two feet of the exhausted chamber offered the same resistance as ¼-inch of atmospheric air; and yet this offered sufficient resistance not to allow a current from 400 cells of Daniell's battery to pass across the wires in the exhausted chamber, being very close, about $\frac{1}{50}$-inch apart. Consequently, you get by this means, I think, the nearest approach to a perfect lightning-conductor. Some of these lightning-conductors have been in use upon our lines; and in one case, at Rugby, owing to not anticipating the result I am about to describe, the machine was improperly constructed. Ten wires were led up into the exhausted glass through a slate tablet; these were all cemented in, and the glass was made tight by filling round it with cement, and covering over the tap that had been used for exhausting the glass with the same soft cement which had been carefully deprived of moisture. A little vacuum gauge was placed inside the glass to show that the vacuum was maintained. A heavy flash of lightning struck the wires on the Trent Valley line, and was discharged through the lightning-conductor in the Rugby office; the wires were heated by the discharge, and the heated wires melted the cement, which was violently projected inwards by the pressure of the atmosphere coating the glass and filling the vacuum gauge. None of the instruments were injured, and as far as that experience goes, which is the only experience we have had of a heavy discharge going through the instrument, it answers perfectly. In the case of a submarine cable, I should always recommend the introduction of at least three or four miles of underground wire between the cable and the land line; the discharge would be most likely to take place in it to the earth, and save the cable. This is not, however, always the case, for in sandy or rocky districts the ground is sometimes struck, and the ground being dry offers so much resistance to the discharge that the lightning bursts into the gutta-percha, and comes out again at some more distant point. As under-ground wires are sometimes destroyed by lightning, so under-ground wires connected with a cable might be destroyed by lightning; but the safest means of protecting a submarine cable is to solder a thick wire to every individual wire of the exterior covering of the cable, and to use those wires as the earth connection of your lightning-conductor, which should be a vacuum one, such as I have just described. Then if the ground itself be to a certain extent an insulator, and lightning flash into your wire, it will go to the exterior of the cable at once, because that is the best connection with the earth at that point; and having charged the exterior of the cable for a moment, which it will do at that very instant, which is the dangerous moment, the interior of the cable has no power to take in electricity, as Faraday has shown by an insulated jar, in which, when you place a charged ball, and let that ball touch the interior of the vessel, the electricity immediately escapes to the exterior; and upon taking that ball out, there is not a trace of electricity there. Therefore, the exterior metal covering of the cable is the next earth connection that can be selected for preserving the cable. I would, however, recommend that at the end of the length of underground wire of five miles, where it joins the land line, you should also have another lightning-conductor. There is then a double chance, and that is very important in submarine cables. However, should the submarine cable be destroyed by lightning, it will probably take place within a distance of fifteen or twenty miles at most, at which repairs are easily performed.

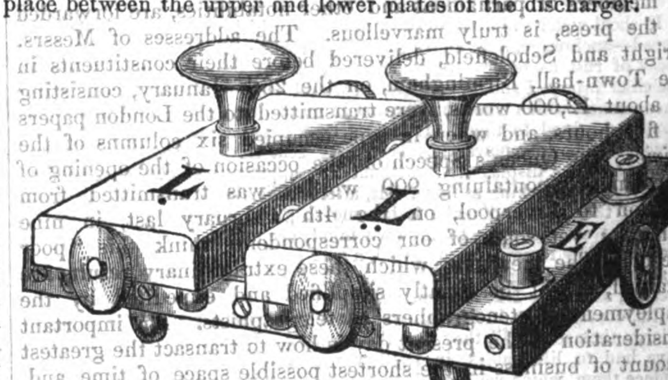
Mr. W. H. Preece, A.I.C.E., in his evidence supplies some interesting facts illustrative of the imminent danger to which telegraph lines are exposed in the absence of precautionary measures. It appears that in the summer of 1859 a very severe storm occurred in Jersey. The land wires were struck by a flash of lightning; a portion of it rushed into the office, and destroyed the instruments, while the other portion found its vent in two places, producing small punctures in the insulated wire, and the remainder of it disappearing in the cable. The fault in the land wires were very soon found out, and still remained giving a resistance equal to 160 miles without getting better or worse. It appears that the lightning before it produced the fault in the cable must have ran along it for some sixteen miles; it then found, as Mr. Preece supposed, a weak spot, and made its way out. Mr. Preece, in reply to the interrogatories of the members of the Government committee, proceeds:—

Do you suppose that there was an eccentric part where the wire was nearer to the water than at any other place ?—Most probably, or it may be an air-hole in the gutta-percha; but it is not a serious fault in such a short circuit; that is the only instance I have experienced of a cable being seriously damaged by lightning. There is an effect in one of the specimens I have produced before the committee which I can only attribute to lightning; at one end of the wire it appears to have been a good deal blown out. Do you imagine that was produced by a thunderstorm ?—There was a thunderstorm between the break and the time it was repaired; it has such a peculiar effect that I attribute it to lightning. If lightning passed along the wire would it not escape at the part where it had the nearest access to water ?—Yes. This specimen looks like the inside of a fuse after it is discharged ?—Yes, just as if it had been fused. Do you adopt any special precautions where submarine cables approach the land ?—I have not hitherto done so, but I have ordered lightning-conductors for each shore end, and intend fixing them. (Mr. Preece then describes the apparatus he proposed to adopt being the same as that already described by Mr. Latimer Clark in his evidence.) Examination continued: You do not mind the coil being fused ?—No; we have always spare instruments, and we find more accidents and derangements arise from the use of lightning-conductors than benefit. You would only adopt lightning-conductors to submarine cables, but in those cases you would invariably use them ?—Yes. Did the lightning appear to enter at the underground wires ?—Yes. Not forming a connection with the underground wire ?—No; it appears to have entered the underground wire itself. Does the underground wire run to the office the whole distance ?—Yes; there is no wire above ground between the office and the sea. How can you account for that ?—The hill upon which the lightning seems to have struck is a granite hill; the wire goes under the road to the top, and the lightning seems to have struck the top of this hill. There is a brook running down one side of the hill, and the lightning seems to have struck somewhere near that spot; at that spot it seems to have gone into the wire; the mark of its going into the wire is at that very place; it has a certain peculiar appearance that we have often noticed in accidents to underground wires from lightning; they have a peculiar look as if they had been burst outward; in this case it seemed to take an opposite direction. Is not that the appearance it generally puts on (handing the witness a specimen of core injured by lightning) ?—Yes, it is very similar to that. This shows as if it had come out of the wire; but this, on the contrary, was like a crater, indented just in the opposite way. Did you cut the gutta-percha out where it was indented ?—Yes, we took a piece out. Did you find where it was indented that the copper was fused ?—Yes, it was burnt as if a blow-pipe flame had been acting upon it. There was also a spot at the bottom of the hill where it had evidently got out; and there is a fault existing in the cable, which I have not the slightest doubt is something similar to that. It is a fault so trivial in amount that we have paid no attention to it.

Mr. C. W. Siemens, F.R.S., in his examination, states:—

With regard to the injury occurring to these cables by lightning, it is not possible to make such arrangements on shore as to avoid the possibility of those injuries by means of lightning-conductors ?—I think there are several means by which those dangers might be avoided. The first is, to put a good lightning-discharger near the place of the landing of the cable. It is not sufficient, I consider, to place such a lightning-discharger near the station, because lightning, striking the suspended land wire, will not find sufficient discharge at the station, but will discharge in both directions, and the cable may be injuriously affected by such discharge. A very safe way of avoiding the lightning discharges upon the cable, where there are short land lines connected with them, is, in my judgment, a wire suspended in contact with the earth over the land wire in connection with the cable. Such an arrangement would be very inexpensive.

It is gratifying to find that where efficient dischargers are employed the cables have escaped danger. Mr. Buffleb, the electrician to the Levant Submarine Telegraph Company, in a communication from Chios, states that the company's cables had, for the third time, been saved from destruction owing to the employment of electric conductors. During a heavy thunderstorm which passed over the island of Metelin, eight of the poles were completely destroyed, and the electric fluid passed over the line-wire into the cable-box, where it was fortunately arrested from entering the cable by the fusion which had taken place between the upper and lower plates of the discharger.



The above illustration and the following description of the apparatus (supplied by Messrs. Siemens, Halske, & Co.) will enable our readers to understand its construction and action:—

This instrument consists of a large metallic "ground," or "earth" plate, E, so called from being brought into connection with the wires leading to the earth, and one or more smaller iron plates, L and L, called "line." plates, each line plate being connected with one of the lines entering the station and with its respective instrument. The whole of these plates are insulated from each other by the interposition of vulcanite; but the under surface of the line plates are brought into such close proximity with the upper surface of the earth plate as to leave a very small space of air between them.

The metal parts are varnished to prevent rusting. On account of the large metal surfaces standing opposite each other, and separated only by a thin space of air, small as well as heavy charges of atmospheric electricity in the line pass easily from the line plate to earth through the medium of air, which is impenetrable by the electricity used in working the line.

It sometimes happens that small particles of metal are separated from the plates by heavy discharges of atmospheric electricity, which, though they form metallic contact between line and earth in the station, do not, at least, make the discharger unfit to lead off the dangerous and destructive effects of succeeding discharges, as is the case with dischargers with points, which is very important; such particles are, however, easily removed by lifting the upper or line plate, when the surfaces can be dusted, and such particles of metal removed without disturbing the connections.

These lightning dischargers are generally made with two line plates, because, on a single wire line two line wires enter each intermediate station; but they are also made with only one line plate for end stations, or with three or more, as may be required, the earth plate being decreased or increased accordingly.

STENOGRAPHY AND TELEGRAPHY.

During the past two months a very interesting discussion has been carried on in our columns, under the heading of "Telegraphic Feats," from which good, no doubt, will arise, as it has brought the merits of different inventions into wholesome contrast. Our correspondents (generally persons in the service of telegraph companies) have evinced a very natural partiality for the system and apparatus which they each use, and, notwithstanding that great discrepancy is manifest in the statements as to the rates of transmission per minute or hour, attributed to the several instruments employed, they all agree that, in this respect, much depends upon the capacity of the clerk or clerks at the sending and receiving stations. The dispatch and accuracy with which long and important speeches of members of parliament and other notabilities, are forwarded to the press, is truly marvellous. The addresses of Messrs. Bright and Scholefield, delivered before their constituents in the Town-hall, Birmingham, on the 26th January, consisting of about 12,000 words, were transmitted to the London papers in five hours, and when in type occupied six columns of the Times; the Queen's Speech on the occasion of the opening of Parliament (containing 900 words) was transmitted from London to Liverpool, on the 4th February last, in nine minutes; yet some of our correspondents think this "poor speed." The means by which these extraordinary results are attained, might be greatly simplified and expedited by the employment of stenographers as telegraphists. An important consideration in the present day is how to transact the greatest amount of business in the shortest possible space of time, and, in cases like those to which we have alluded, every hour saved is of the utmost consequence.

At present it is customary for reporters to transcribe their verbatim short-hand notes into long-hand, before placing copy in the hands of the telegraph clerks, a process which occupies, perhaps, one-half the time intervening between the delivery of a speech, and its transmission to any remote locality. Now, were telegraph clerks acquainted with the principles of stenography, they would be (if otherwise well-educated) capable of sending reports from short-hand notes, and thereby effect an immense saving of time and labour; one transcription, and that at the receiving station, for the printer, proving all that is needful. It seldom happens that more than five or six wires are used on these occasions, and it would be well for the managers of large telegraph establishments to consider whether it would not be profitable to keep a staff of qualified clerks for this description of business. Another, and to all intents a more efficient plan to facilitate the speedy reporting of political and after-dinner harangues, would be for our companies to supply them to the daily papers at their own cost, *à la Reuter.* They could then, by offering adequate remuneration, secure the services of clerks qualified to perform the duties of reporters and transmitters. To illustrate our proposition, we will suppose that a public demonstration is about to take place at Southampton. The telegraph company whose lines extend to that district will instruct, say, six reporting clerks to attend. After the proceedings commence, each one, in order previously arranged, could leave the meeting half-hourly with his notes, proceed to the instrument-room, transmit the same, and return to relieve a compeer at the meeting. They would thus be able to forward their report direct to its destination by the wire, save the delay and cost of transcription, and avoid any confusion or hesitation in deciphering bad manuscript. These suggestions, which we shall enlarge upon at some future time, could be adopted where the Morse and bell instruments are used, by those who employ Hughes' printing machine, and with great effect by the Bonelli Company, in which latter case writing, after the short-hand notes, could be dispensed with entirely. The now general system of realising any given plan by a division of labour, has begotten methods of action which, in particular cases, frustrate the end in view. Six clerks, possessing the qualifications we have enumerated, could report and transmit a speech, by this plan, quicker and cheaper than twelve persons proceeding in the present routine manner. These recommendations are inapplicable to the ordinary commercial business of the telegraph, where it is necessary to have every despatch written in full by the person for whom it is sent, but for newspaper work the employment of stenographers by telegraph companies, certainly appears to possess many and decided advantages. They need not be kept exclusively for reporting, but if a limited number were placed on the staff, they could, whenever required, betake themselves to any district, transact their special business, and return to their ordinary avocations.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 164.)

The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2,978) exhibit a magneto-electric dial instrument, invented by Professor Wheatstone. In the transmitting instrument the armature of a permanent magnet is kept in continuous motion by the hand of the operator, or by any other moving power; and finger-stops corresponding with the letters on the dial of the telegraph, on being respectively pressed down, determine the passage of the currents in the proper number and order to produce the required motion of the index at the receiving end. By this means the operator can act on the finger keys with perfect facility, however large the magnets and armatures may be, which is not the case when the armature itself is required to be stopped. The continuous motion of the armature has another great advantage over the old starting and stopping system; it avoids the risk already alluded to, that both on stopping and starting the operator will move his handle too slowly, and that he will move it at a different

speed, when few or many letters have to be passed. Every alteration of speed is, of course, accompanied by an alteration of the strength of the current sent, whereas in Professor Wheatstone's instrument the motion of the armature is perfectly regular, and consequently equal currents are sent at all times.

The arrangement of the induction coils and armature is peculiar. Four soft-iron cylindrical cores with their coils are fixed to each pole of a permanent magnet, so that their centres are equidistant from each other in the circumference of a circle. An axis passing through the centre of this circle carries a soft-iron armature, the breadth of which is a little greater than the distance between two adjacent cores. Thus, when the armature revolves it approaches one pole as it recedes from that diagonally opposite. The currents induced simultaneously in the two corresponding coils concur to produce a current in one direction through the line wire. During each revolution of the armature four currents are induced, all equal, each resulting from two coils.

The arbor, which is geared with the axis of the armature, carries a brass wheel, on the periphery of which are fifteen little teeth spaced equally, but at some distance apart; this wheel continually revolves. An armature with an index attached is centred on this arbor, and can move freely round it, but so long as a spring catch on its end is in contact with one of the teeth of the above-named wheel the arm revolves along with the wheel. The arm and wheel form part of the telegraphic circuit, which is complete so long as they revolve together, but is interrupted whenever the catch is not in contact with any tooth of the wheel. Thirty finger-stops are so placed that the depression of any one of them shortly afterwards stops the index arm, the spring catch allows the wheel to pass, and the circuit is broken, except for the very short moments when a tooth touches the spring catch in passing. These moments correspond to a position of the armature when no current is induced, and the contacts might be allowed to take place without detriment. The circuit in the instrument exhibited is, however, broken in a second place by a little spring and lever, the latter of which is thrown back by coming in contact with the finger-stop.

The transmission of currents into the line is, therefore, entirely interrupted so long as the motion of the index arm is arrested. When the stop rises the little lever returns to its contact at once, but the circuit is only complete when contact is made between the sending arm and one of the little catches on the periphery of the revolving brass wheel at a moment corresponding to that of the inversion of the current; thus, imperfect currents are prevented from entering the circuit, and the opposite current to that last sent before the arm was stopped is first sent when it starts again. So long as no key is down currents continue to pass into the circuit; but to avoid useless currents, adding unnecessarily to the chances of failure, a contrivance is adopted by which any one of the finger-stops which may have been depressed remains so, even when the finger is removed, until another stop is put down, when the former is restored to its normal position. This is effected by an endless chain passing round a series of friction rollers so placed as to form a circle concentric with the circle in which the finger-stops are arranged, and having just "slack" enough to allow of the depression of one stop only. The finger-stops are so constructed, that when any one of them is depressed, it presses against the endless chain and tightens it, and when another stop is subsequently depressed it bears in like manner against the chain, so that the flexure made by the former stop is obliterated, and that stop lifted to its normal position.

In the receiving instrument both the propelment and the electro-magnetic arrangements are novel and ingenious. To form the latter, two magnetic needles or bars, with their poles in opposite directions, are placed near each other on opposite sides of, and parallel to, the axis on which they rock; two straight electro-magnets are placed one on each side of the axis of motion of the needles, and parallel to it. When a current arrives through the coils of these electro-magnets the dissimilar poles of the two needles are simultaneously acted on, so that each of their poles is attracted by one pole of one electro-magnet, and repelled by one pole of the other electro-magnet: the attracting and repelling motions all concur in rocking the pair of magnets on the axis in the same direction. The magnets are curved in towards each other towards the middle of their length, so as to throw their weight nearer the axis of motion. The attraction from the residual magnetism remaining in the electro-magnets after the current has ceased, is sufficient to hold the magnets firmly on one side.

A very similar arrangement with several magnets, and coils round the prolongation of one axis is used for Professor Wheatstone's Steinheil receiving instrument employed with the automatic sender.

In the propelment the axis of the propelling wheel, instead of being fixed, is attached to a short rocking lever, moved backwards and forwards by a pin connected with the magnetic armature. Two fixed pallets act on teeth at opposite points of the circumference of the wheel, to which a rotatory motion is given by its being moved to and fro between the two pallets by the rocking lever. The motion is limited by two fixed pins, against which the propelling wheel impinges at the opposite limits of its oscillation. Each pallet consists of a very light spring placed tangentially to the circumference of the wheel; it yields readily to the tooth passing beneath when the opposite tooth is propelled by the other pallet, and then falls into its place ready to propel the tooth which has passed beneath it. To prevent the oscillatory motion of the wheels from being communicated to the index, the axis of the latter is detached from that of the former, and is driven by a pin. This propelment moves the index with great regularity; no tooth can slip, and a very weak current is sufficient to work the index. All the parts are constructed with extraordinary delicacy and lightness: indeed, the workmanship of this receiving instrument is unrivalled among the telegraphic apparatus. Two of these little instruments worked perfectly through a circuit of resistance equal to that of about 375 miles of No. 8 iron wire. One of the instruments worked perfectly through 450 miles. They have been practically used on circuits of more than 100 miles. This apparatus has great advantages over even good instruments of the old class, in which the coils or the armatures are alternately stopped and started. These instruments are now extensively adopted in this country, especially for private communication between docks, warehouses, shops, offices, &c.

H. Wilde, Manchester (United Kingdom, 2,992), exhibits magneto-electric dial instruments with two forms of transmitter. In one he has adopted the arrangement of coils and armature invented by Professor Wheatstone, and shown in the instrument exhibited by the Universal Private Telegraph Company. Mr. Wilde, moreover, provides for the rapid and equal motion of his armature by using the continuous driving motion of a strap worked by a treadle, but instead of simply breaking the connection between the line and the coils during any pause at a letter or between words, Mr. Wilde arrests his armature by the depression of finger-stops. When the armature is so arrested the driving-band simply slips on its pulley; so soon as the finger is removed from the stop it rises, and the armature is allowed to start at full speed, being driven by the band. Mr. Wilde, to allow of the sudden start and stoppage of his armature, has been forced to make it extremely light, and by so doing has very much weakened the induced currents.*

The other form of transmitter is worked with a reciprocating motion by hand, and is certainly superior to Mr. Wilde's circular form. In it a reciprocating rectilinear motion is substituted for the usual circular motion of the axial arm. This rectilinear motion is converted into a circular motion by a nut on a double or triple threaded screw; this screw carries two armatures round in front of two pair of coils on two compound horseshoe magnets; the one armature approaches the centre of its coils, while the other recedes. The coils are connected in series, so that the currents induced by both armatures agree; and this arrangement produces a succession of equal and opposite currents. The nut which drives the screw is driven backwards and forwards from one position to another by one hand, and is abruptly stopped in each fresh position by being brought sharply against a pin previously placed with the other hand in a hole opposite the corresponding letter. Thirty letters or symbols are marked down one side of the slot in which the nut moves, and thirty similar letters or symbols up the other side; the nut must always be moved down to the letters on one side, and up to the letters on the other, passing to the extreme end in each case before changing the direction of the motion; in fact, the nut must work round and round the alphabets. Mr. Wilde considers this plan cheaper than the usual circular arrangement.

The receiving instrument has considerable merit; the propelment is well devised, and the workmanship of the instrument is good. It contains an alarum which is started by the step-by-step propelment without any separate electro-magnet. It is driven by a barrel-

* The above is the opinion of the writer and of several of the other jurors. Mr. Wilde dissents from this opinion, and quotes Barlow, Kater, and other authorities, to show that a light armature may be as good as a heavy one; the writer is, however, of opinion that, although a light armature of good form may be better than a heavy armature of bad form, nevertheless, when the material is in each case disposed in the most effective manner, the heavy armature will always be much superior to the light armature.

spring and clockwork, and continues ringing until stopped by hand. The propelment used may be described as follows:—

Two ratchet or star wheels, each with fifteen pointed teeth, are geared together by two ordinary spur-wheels of equal diameter, one on the axis of each star-wheel. The two faces of each tooth of the star-wheels form two sides of an equilateral triangle, and the diameter of the wheels is such that the teeth just clear one another. The dial-index or pointer is on the axis of one of the wheels; a little pin moved by the armature of an electro-magnet oscillates between the two star-wheels, and causes their revolution; when moving to the right it bears against, say, the under inclined surface of a tooth of the right-hand wheel, and by so doing turns that wheel from left to right one-thirtieth of a revolution; the other star-wheel, of course, moves an equal distance from right to left; when the pin comes back towards the left it leaves the right-hand star-wheel, and presses against the under inclined surface of a tooth on the left-hand wheel, turning it one-thirtieth of a revolution from right to left, while, owing to the gearing, the right-hand wheel moves on an equal distance in the same direction as before, and the under surface of a fresh tooth on this wheel is now in a position to be acted on; thus, the slight to-and-fro motion of the pin is converted into a step-by-step rotation of the index on the right-hand wheel. In this arrangement there are no adjustments, spring-stops, or pallets; it is impossible for the index to fly round so as to slip a tooth, for the little pin is always in the way of either one or other star. The friction caused by the gearing, and by the indirect action of the pin on the star-wheels, is probably greater than that of Wheatstone's or Siemens' propelments. Mr. Wilde's propelment works well, however, even at very high speeds.

With the reciprocating transmitter, Mr. Wilde's dial instrument worked correctly with a resistance of about 140 statute miles of No. 8 iron wire in circuit. It was admitted that the circular transmitter would not have worked through nearly so large a resistance, but Mr. Wilde considered this due to no defect of design, but to the fact that the instrument exhibited was the first instrument of the kind made.

(b.) *Step-by-step Letter-showing Instrument worked by Voltaic Induction Currents.*—A dial instrument of this kind is shown by T. Allan, M. (United Kingdom, 2,850).

The transmitter has four electro-magnetic primary and secondary induction coils on four straight soft-iron cores, so placed as to form the sides of a square; the four coils are so connected as to act like one. The instrument has a dial with stops corresponding to the letters of the alphabet; a train of clockwork drives an arm on the axis of this dial, and a notched wheel, by which the current in the primary coil is reversed twenty-six times during each revolution of the axial arm. When a stop is depressed the arm is arrested by it, and stops the clockwork and reversing wheel. They start again when the stop is released, and continue to send reversals through the primary coil, until the arm is arrested by the depression of another stop. The secondary coil sends a number of signals along the line corresponding to the number of reversals in the primary coil, and so works the step-by-step receiving instrument. The closed rectangle of soft-iron, although it exhibits no external sign of polarity, is said to be far preferable to a straight or horseshoe core for the induction coils. In corroboration of this opinion experiments made by the exhibitor were quoted, from which it appeared that when the four coils were arranged in a straight line the receiving instrument could only be worked with about one-half of the resistance in circuit, which might be introduced when they were arranged in a continuous square, and that the presence of even a piece of cardboard at one corner interrupting the continuity reduced the resistance through which signals were received by one-third. A simple induction coil made on this plan is also exhibited by Mr. Allan.

The index of the receiving instrument is worked by a very simple propelment. The armature of the receiving electro-magnet moves a little toothed wheel to and fro between fixed stops so placed that they each turn the wheel one twenty-sixth of a revolution; the index is on one end of the axis of this little toothed wheel, and the axis is made of such length that the slight play required to allow the to-and-fro motion of the wheel is quite insensible at the index end. The writer considers that it is just possible for the index to slip past the stops when currents cease to be received. The receiving instrument is otherwise very similar to that exhibited in 1851, and could, of course, be worked by magneto-electric or simple battery currents.

(c.) *Step-by-step Letter-showing Instruments worked by Voltaic Currents.*—The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2,978) exhibit a simple and excellent transmitter, by which alternately inverted currents are sent. The letter circle or wheel is composed of a number of flexible spokes or radii corresponding to the different letters or signs, and proceeding from a common central axis, which also carries a spur-wheel. A finger-pin is fixed on the end of each spoke. When any letter is to be sent the corresponding finger-pin is pressed down, deflecting the spoke, and the axis is then turned round by the finger until a prolongation of the finger-pin comes in contact with a fixed stop, when the required number of contacts will have been sent, and the spoke may be allowed to rise. The required succession of contacts is made in a very simple manner by a second axis making half a revolution for each letter, and turned by a pinion driven from the spur-wheel on the main axis.

This transmitter is equally well adapted for working a step-by-step instrument with volta-induction currents. The battery current passes through a short circuit at the moment of inversion, so as to avoid the spark, which would otherwise occur when the circuit is broken.

E. Tyer (United Kingdom, 2,977) exhibits a step-by-step dial instrument worked with voltaic currents. His sending instrument is arranged to send reverse currents, as in the latest French instruments of this kind. He uses rubbing contacts made by a spring from a radial arm, instead of the dead pressure contacts used in France. He drives his radial arm by clockwork, and stops it by keys opposite the required letter, instead of turning it by hand. The finger-keys are compactly arranged in parallel rows, an arrangement which seems preferable to the circular one.

The propelment of his receiving dial consists of two light ratchet-wheels on the axis of the index, with their teeth on the face of the wheels, instead of on the periphery. These teeth face one another, and the inclined surfaces of the teeth, which are nearly opposite one another, both converge, so that a little pin, worked to and fro between the wheels by the armature, moves the axis round step by step, first pressing on the inclined surface of one tooth of one wheel, and next on the corresponding surface of a tooth in the other wheel; the points of the teeth of one wheel are opposite the centres of the inclined surfaces of the teeth of the other wheel. This propelment seems good, but the arrangement of the receiving electro-magnet and armature used with it is not satisfactory, and a trial of the instrument gave indifferent results. Mr. Tyer observed, however, that this was the first instrument of the class made by him, and intended rather as a model than for actual work. He is of opinion that he could construct instruments on this plan equal to any others.

Digney Brothers & Co., Paris, M. (France, 1,414), exhibit a step-by-step dial instrument worked by voltaic currents. Their transmitting apparatus is very similar to that shown by M. Bréguet, Paris, M. (France, 1,413), and long used in France. A radial sending arm moves a disc round, in the lower surface of which a serpentine groove is cut; a lever rocking on a vertical axis is worked by a projection fitting into this groove. M. Bréguet, who works with single currents and interruptions, has only one of these rocking levers; Messrs. Digney, who work with reverse currents, require two. The index of the receiving dial is in both instruments driven by clockwork, of which the electric current works the escapement, used instead of the propelment of the English magneto-electric instruments.

The motion of the pallet in each case is in the plane containing the axis of the escapement, instead of being in a plane perpendicular to it, as in the usual propelments and in clock escapements. Messrs. Digney use a little forked pallet in their escapement; when one of the forks moves so far on one side as to let a tooth slip, the other is in the right position to catch the next tooth, which it lets pass in its turn on coming back to the first position. M. Bréguet, instead of a forked pallet, uses a plain pallet between two ratchet-wheels, catching first one and then the other, and letting their axis make one twenty-sixth of a revolution each time.

M. Bréguet has an ingenious mode of sending the index back to the zero or cross by one touch of a button. He uses the common electro-magnet with an adjustable antagonistic spring.

Messrs. Digney use Siemens' polarized electro-magnet, which allows them to dispense in a great measure with any adjustment during use. Messrs. Digney's instrument was worked freely by three Daniell's cells, with 200 kilometres of iron wire 4 millimetres diameter in circuit.*

* This is equal to about 150 miles of No. 8 iron wire.

Neither of these instruments could be worked at the speed of the English magneto-electric instruments. In that of M. Bréguet, one contact too many is sometimes made by the rocking lever if the handle be stopped too suddenly; this lever ends in a spring, and works through a considerable space (nearly ¼ inch). It is consequently in a state of violent vibration, and, if worked too fast, springs back from the last contact, giving an interruption and a consequent extra current. Both M. Bréguet's and MM. Digney's look complicated beside the magneto-electric instruments, but their price is considerably less. Messrs. Digney's receiver and transmitter are supplied complete for £10.

(To be continued.)

THE DOT AND LINE ALPHABET.

The following humourous and entertaining communication was addressed to the *Atlantic Monthly*, by the Rev. Edward E. Hale, on the variety of purposes to which the dot and line alphabet might be employed. We understand that communications were carried on with ease and accuracy, between the vessels engaged in laying the Persian Gulf cable, by the exhibition of light, at intervals corresponding with the dot and line alphabet; a momentary appearance of the light indicating a *dot*, and one of a short duration a *line* or *dash*:—

Please to understand, then, ignorant reader, that this curious alphabet reduces all the complex machinery of Cadmus, and the rest of the writing-masters, to characters as simple as can be made by a dot, a space, and a line, variously combined. Thus, the marks - — designate the letter A. The marks — - - - designate the letter B. All the other letters are designated in as simple a manner. Now I am stripping myself of one of the private comforts of my life, (but what will one not do for mankind?) when I explain that this simple alphabet need not be confined to electrical signals. *Long* and *short* make it all,—and wherever long and short can be combined, be it in marks, sounds, sneezes, fainting-fits, canes, or children, ideas can be conveyed by this arrangement of the long and short together. Only last night, I was talking scandal with Mrs. Wilberforce, at a summer party at the Hammersmiths. To my amazement, my wife, who scarcely can play "The Fisher's Hornpipe," interrupted us by asking Mrs. Wilberforce if she could give her the idea of an air in "The Butcher of Turin." Mrs. Wilberforce had never heard that opera, indeed, had never heard of it. My angel-wife was surprised, stood thrumming at the piano, wondered she could not catch this very odd bit of discordant accord at all, but checked herself in her effort, as soon as I observed that her long notes and short notes, in their tum-tee-tee, tee-tee, tee-tum-tum, meant "He's her brother." The conversation, on her part, turned from "The Butcher of Turin," and I had just time, on the hint thus given me by Mrs. I., to pass a grateful eulogium on the distinguished statesman whom Mrs. Wilberforce, with all a sister's care, had rocked in his baby-cradle, whom, but for my wife's long and short notes, I should have clumsily abused among the other statesmen of the day.

You will see in an instant, reader, that it is not the business simply of "operators" in telegraphic dens to know this Morse alphabet, but your business, and that of every man and woman. If our school-committees understood the times, it would be taught, even before phonography, or physiology, at school. I believe both these sciences now precede the old English alphabet.

As I write these words, the bell of the South Congregational strikes dong, dong, dong,—dong, dong, dong,—dong, dong, dong. Nobody has unlocked the church-door. The old tin sign, "In case of fire, the key will be found at the opposite house," has long since been taken down, and made into the nose of a waterpot. Yet there is no Goody Two-Shoes locked in. No! But, thanks to Dr. Channing's Fire Alarm, the bell is informing the South End that there is a fire in District dong, dong, dong,—that is to say District No. 3. Before I have explained to you so far, the "Eagle" engine, with a good deal of noise, has passed the house on its way to that fated district. An immense improvement this on the old system, when the engines radiated from their houses in every possible direction, and the fire was extinguished by the few machines whose lines of quest happened to cross each other at the particular place where a child had been building cob-houses out of lucifer-matches in a paper warehouse. Yes, it is a very great improvement. All those persons, like you and me, who have no property in district dong-dong-dong, can now sit at home at ease, and little need we think upon the mud above the knees of those who have property in that district, and are running to look after it. But for them the improvement only brings misery. You arrive wet, hot or cold, or both, at the large District No. 3, to find that the lucifer-matches were half-a-mile from your store, and that your own private watchman, even, had not been waked by the working of the distant engines. Wet property-holder, as you walk home, consider this. When you are next in the Common Council, vote an appropriation for applying Morse's alphabet of long and short to the bells. Then they can be made to sound intelligibly. Daung ding ding, ding, ding daung, daung daung daung, and so on, will tell you, as you wake in the night, that it is Mr. B.'s store which is on fire, and not yours, or that it is yours, and not his. This is not only a convenience to you and a relief to your wife and family, who will thus be spared your excursions to unavailable and unsatisfactory fires, and your somewhat irritated return, but it will be a great relief to the Fire Department. How placid the operations of a fire where none attend except on business. The various engines arrive, but no throng of distant citizens, men and boys, fearful of the destruction of their all. They have all roused on their pillows to learn that it is No. 530, Pearl-street, which is in flames. All but the owner of No. 530, Pearl-street, have dropped back to sleep. He alone has rapidly repaired to the scene. That is he who stands in the uncrowded street with the chief engineer, on the deck of No. 18, as she plays away. His property destroyed, the engines retire; he mentions the amount of his insurance to those persons who represent the daily press, they all retire to their homes; and the whole is finished as simply, almost, as was his private entry in his day-book the afternoon before. This is what might be, if the magnetic alarm only struck *long* and *short*, and we had all learned Morse's alphabet. Indeed there is nothing the bells could not tell; if you would only give them time enough. We have only one chime for musical purposes, in the town. But, without attempting tunes, only give the bells the Morse alphabet, and every bell in Boston might chant, in monotone, the words of "Hail Columbia!" at length, every fourth of July. Indeed, if Mr. Barnard should report any day that a discouraged prentice-boy had left town for his country home, all the bells could instantly be set to work to speak articulately, in language regarding which the dullest imagination need not be at loss,

"Turn again, Higginbottom,
Lord Mayor of Boston!"

I have suggested the propriety of introducing this alphabet into the primary schools. I need not say I have taught it to my own children, and I have been gratified to see how rapidly it made head against the more complex alphabet in the grammar schools. Of course it does. An alphabet of two characters, matched against one of twenty-six, or of forty odd, as the very odd one of the phonotypists employs! On the Franklin medal-day I went to the Johnson School examination. One of the committee asked a nice girl, what was the capital of Brazil. The child looked tired and pale, and, for an instant, hesitated. But, before she had time to commit herself, all answering was rendered impossible by an awful turn of whooping-cough which one of my own sons was seized with, who had gone to the examination with me. Hawm, hem hem; hem hem hem; hem, hem; hawm, hem hem; hem hem hem; hem hem,—barked the poor child, who was at the opposite extreme of the school-room. The spectators and the committee looked to see him fall dead with a broken blood-vessel. I confess that I felt no alarm, after I observed that some of his gasps were long, and some very *staccato*; nor did pretty little Mabel Warren. She recovered her colour, and, as soon as silence was in the least restored, answered, "*Rio* is the capital of Brazil," as modestly and properly as if she had been taught it in her cradle. They are nothing but children any of them; but that afternoon, after they had done all the singing the city needed for its annual entertainment of the singers, I saw Bob and Mabel start for a long expedition into West Roxbury, and, when he came back, I know it was a long featherfew, from her prize school-bouquet, that he pressed in his Greene's "Analysis," with a short frond of maiden's hair.

I hope nobody will write a letter to *The Atlantic*, to say that these are very trifling uses. The communication of useful information is never trifling. It is as important to save a nice child from mortification on examination-day, as it is to tell Mr. Fremont that he is not elected President. If, however, the reader is

distressed because these illustrations do not seem, to his more benighted observation, to belong to the big bow-wow strain of human life, let him consider the arrangement which ought to have been made years since, for lee shores, railroad collisions, and that curious class of maritime accidents where one steamer runs into another under the impression that she is a lighthouse. Imagine the Morse alphabet applied to a steam-whistle, which is often heard five miles. It needs only *long* and *short* again. "*Stop Comet*," for instance, when you send it down the railroad line, by the wire, is expressed thus:—

. . . — . . . .

. . . . . — — . —

Very good message, if Comet happens to be at the telegraph station when it comes! But what if Comet has gone by? Much good will your trumpery message do then! If, however, you have the wit to sound your long and short on an engine whistle, thus:—Scre scre, scre; screeeee; scre scre; scre scre scre scre; scre scre—scre, scre, scre, screeeee screeeee; scre; screeeed,—why, then the whole neighbourhood, for five miles round, will know that Comet must stop, if only they understand spoken language; and, among others, the engineman of Comet will understand it; and Comet will not run into that wreck of worlds which gives the order,—with his nucleus of hot iron and his tail of five hundred tons of coal. So, of the signals which fog-bells can give, attached to lighthouses. How excellent to have them proclaim through the darkness, "I am Wall!" Or of signals for steam-ship engineers. When our friends were on board the "Arabia" the other day, and she and the "Europa" pitched into each other,—as if, on that happy week, all the continents were to kiss and join hands all round—how great the relief to the passengers on each, if, through every night of their passage, collision had been prevented by this simple expedient! One boat would have screamed, "Europa, Europa, Europa, Europa," from night to morning, and the other, "Arabia, Arabia, Arabia," and neither would have been mistaken, as one unfortunately was, for a lighthouse. Any passenger who has ever had a state-room next the whistle will testify to the sense of secure comfort this nightly chorus would give him.

The long and short of it is, that whoever can mark distinctions of time can use this alphabet of long-and-short, however he may mark them. It is, therefore, within the compass of all intelligent beings, except those who are no longer conscious of the passage of time, having exchanged its limitations for the wider sweep of eternity. The illimitable range of this alphabet, however, is not half disclosed when this has been said. Most articulate language addresses itself to one sense, or at most to two, sight and sound. I see, as I write, that the particular illustrations I have given are all of them confined to signals seen or signals heard. But the dot-and-line alphabet, in the few years of its history, has already shown that it is not restricted to these two senses, but makes itself intelligible to all. Its message, of course, is heard as well as read. Any good operator understands the sounds of its ticks upon the flowing strip of paper, as well as when he sees it. As he lies in his cot at midnight, he will expound the passing message without striking a light to see it. But this is only what may be said of any written language. You can read this article to your wife, or she can read it, as she prefers; that is, she chooses whether it shall address her eye or her ear. But the long-and-short alphabet of Morse despises such narrow range. It addresses whichever of the five senses the listener chooses.

This fact is illustrated by a curious set of anecdotes—never yet put in print, I think—of that critical despatch which in one night announced General Taylor's death to this whole land. Most of the readers of these lines probably read that despatch in the morning's paper. The compositors and others had read it. To all of them it was a despatch to the eye. But half the operators at the station *heard* it ticked out, by the register stroke, and knew it before they wrote it down for the press. To them it was a despatch to the ear. My good friend Langenzunge had not that resource. He had just been promised, by the General himself (under whom he served at Palo Alto), the office of Superintendent of the Rocky-Mountain lines. He was returning from Washington, over the Baltimore and Ohio railroad, on a freight-train, when he heard of the President's danger. Langenzunge loved Old Rough and Ready, and he felt badly about his own office, too. But his extempore train chose to stop at a forsaken shanty village on the Potomac, for four mortal hours, at midnight. What does he do but walk down the line into the darkness, climb a telegraph-post, cut a wire, and apply the two ends to his tongue, to *taste*, at the fatal moment, the words, "Died at half-past ten." Poor Langenzunge! he hardly had nerve to solder the wire again. Cogs told me that they had just fitted up the Naguadavick stations with Bain's chemical revolving disc. This disc is charged with a salt of potash, which, when the electric spark passes through it, is changed to Prussian blue. Your despatch is noiselessly written in dark-blue dots and lines. Just as the disc started on that fatal despatch, and Cogs bent over it to read, his spirit-lamp blew up, as the dear things will. They were beside themselves in the lonely, dark office; but, while the men were fumbling for matches, which would not go, Cog's sister, Nydia, a sweet blind girl, who had learned Bain's alphabet from Dr. Howe at South Boston, bent over the chemical paper, and *smelt* out the prussiate of potash, as it formed itself in lines and dots to tell the sad story. Almost anybody used to reading the blind books can read the embossed Morse messages with the finger; and so this message was read at all the midnight way-stations where no night-work is expected, and where the companies do not supply fluid or oil. Within my narrow circle of acquaintance, therefore, there were these simultaneous instances where the same message was seen, heard, smelled, tasted, and felt. So universal is the dot and line alphabet; for Bain's is on the same principle as Morse's.

The reader sees, therefore, first, that the dot and line alphabet can be employed by any being who has command of any long and short symbols; be they long and short notches, such as Robinson Crusoe kept his accounts with, or long and short waves of electricity, such as those which Valentia will send across to the Newfoundland Bay, so prophetically and appropriately named "The Bay of Bulls." Also, I hope the reader sees that the alphabet can be understood by any intelligent being who has any one of the five senses left him; by all rational men, that is, excepting the few eyeless deaf persons who have lost both taste and smell in some complete paralysis. The use of Morse's telegraph is by no means confined to the small clique who possess or who understand electrical batteries. It is not only the torpedo or the *Gymnotus electricus* that can send us messages from the ocean. Whales in the sea can telegraph as well as senators on land, if they will only note the difference between long spoutings and short ones. And they can listen, too. If they will only note the difference between long and short, the eel of ocean's bottom may feel on his slippery skin the smooth messages of our presidents, and the cat-fish, in his darkness, look fearless on the secrets of a queen. Any beast, bird, fish, or insect, which can discriminate between long and short, may use the telegraphic alphabet, if he have sense enough. Any creature, which can hear, smell, taste, feel, or see, may take note of his signals, if he can understand them. A tired listener at church, by properly varying his long yawns and his short ones, may express his opinion of the sermon to the opposite gallery before the sermon is done. A dumb tobacconist may trade with his customers in an alphabet of short-sixes and long-nines. A beleaguered Sebastopol may explain its wants to the relieving army beyond the line of the Chernaya, by the lispings of its short Paixhans and its long twenty-fours.

THERMO-ELECTRIC CURRENTS IN CIRCUITS OF ONE METAL.

READ BEFORE THE BRITISH ASSOCIATION,

By Fleeming Jenkin, Esq.

The investigations of the author of the following paper into the phenomena which characterise the development of thermo-electric currents in a circuit of one metal by the application of heat, are exceedingly interesting and instructive, and we think the reproduction of the Paper in our columns will be acceptable to those of our readers who have not the opportunity of perusing the expensive transactions of the British Association, before which it was read.

Last year I had the honour of directing the attention of the Association to the fact, that an electric current of considerable intensity may be obtained in a circuit of one metal by the application of heat to one or the other side of an interruption in the wire composing the circuit. The experiment is most simply performed by looping together the two ends of two perfectly similar wires connected to the terminals of a galvanometer, and heating one of

the loops to a white or red heat in a spirit-lamp, or Bunsen's burner. If the one loop rests very lightly on the other a current will be obtained, which in the copper wires will flow from the hot to the cold loop across the joint with sufficient intensity to deflect a moderately sensitive galvanometer, even with a resistance in circuit equal to 1000 miles of No. 16 copper wire.

The electromotive force of the combination is about one-tenth that of a Daniell's cell. With two iron loops a permanent current in the opposite direction is obtained, flowing from cold to hot across the joint, but the electromotive force in this case is very much smaller.

When the loops are drawn tightly together the current ceases, but reappears as soon as the strain is slackened.

I was at the time unable to show the connection between these singular currents and other electrical phenomena, but I am now, in consequence of further experiments undertaken for the Association, able to point out that connection.

The currents were clearly not due to chemical action on the wires; for, in the first place, currents of considerable strength were obtained from two perfectly homogeneous platinum wires, flowing from hot to cold across the loose contact; and in the second place, the direction of the current was different in copper and iron, whereas the chemical action undergone by the wire was alike in the two cases.

The researches of Becquerel, Pouillet, Bluff, Hankel, and Grove were examined, to see whether the electricity produced during combustion, or the properties of flame, would account for the currents, but it was found that all the electrical effects produced by flame could be divided into two classes: first, phenomena depending on the relative position of the two wires in the flame; and secondly, phenomena depending on the voltaic couple formed by the metals used, and the hot vapour acting as an electrolyte between them. My results were independent of the position of the wires in the flame, and could not be accounted for by supposing these wires to form a voltaic couple, inasmuch as though in some cases, where wires of two metals were looped together as described, the current flowed from the metal most attacked across the imaginary electrolyte to the other wire, in other cases it flowed in the opposite direction.

It remained to be seen whether the currents might not have a thermo-electric origin. Last year I imagined that the effect observed might be directly due to discontinuity, but that idea was dispelled by some experiments with loose contacts between wires of different metals, which have thrown great light on the question.

Loops of iron, silver, platinum, gold, and copper wires were combined two by two in all the possible arrangements, and the currents measured which were obtained when one or the other or both loops were heated with loose and tight contacts between them.

A Table was thus formed, which is appended to the present paper.

The resistance of the circuit was so large (2050×10^6, Weber's absolute $\frac{\text{foot}}{\text{seconds}}$) that the inherent resistance of the joint and of the different short wires used in each experiment could be neglected, and the deflections obtained on a reflecting galvanometer could be taken as approximatively proportional to the electromotive force of each combination. The common thermo-electric currents produced by the metallic contact between dissimilar wires almost vanish in comparison with those produced by the loose contacts.

I need not present a complete analysis of the Table, but will speak only of the combination of iron and copper with which the most remarkable results were obtained. When the usual tight metallic contact was made between these two wires and the two loops equally heated, the current first flowed from copper to iron across the joint, and then as the temperature rose ceased altogether, and finally, at a red or white heat, flowed from iron to copper. The maximum deflection obtained in either direction was three divisions. These deflections showed the celebrated inversion discovered by Cumming.

If the pressure between the loops was relaxed, the current ceased altogether; but when the loops were moved, so that the copper became red-hot while the iron was cool, a current flowed from the copper to the iron, or from hot to cold across the joint, giving a deflection of 100 divisions; whereas if the iron was heated red-hot and the copper cooled, a current giving 90 divisions flowed in the opposite direction, or from iron to copper, but from hot to cold as before. Thus in these two cases the loose-contact currents given when one or the other loop was heated, flowed in the opposite direction between the metals, but in both cases from hot to cold across the joint, and were in each case about thirty times as great as the currents given by the thermo-electric difference between the metals.

It was found, on examining the Table, that wherever copper appeared in conjunction with any other of the metals named, the direction of the loose-contact current could invariably be determined by the following rule:—When the copper was the hot wire, the current flowed from the copper to the other metal across the joint; but when copper was the cold metal, the current flowed from the other metal to the copper, or in both cases from hot to cold.

Exactly the contrary was found wherever iron appeared in conjunction with any of the five metals but copper; the current then always flowed from cold to hot. Two copper wires alone gave the largest deflection, of about 220 divisions; and two iron wires alone gave the next largest of those obtained where single metals only were used, but of course in the opposite direction to the deflection from copper.

It was then perceived that all these results would be explained if the thin coating of oxide on the copper wire might be regarded as a conductor with a hot and cold junction, and endowed with thermo-electric properties far more positive than the iron, while at the same time the coating of oxide on the iron wire would have to be regarded as far more negative than the copper. It was, however, difficult to suppose that two bodies so similar in some respects as the oxides of copper and iron should be at opposite extremities of the thermo-electric scale, but the following direct experiment left no doubt on my mind.

A little spiral was made of platinum wire, and a small quantity of oxide of copper laid upon it, and held in a flame till white-hot; another platinum wire was then dipped in the melted mass, when a strong current was at once observed from the hot to the cold wire, as if a loose contact had been made between two copper wires. When either of the oxides of iron was tested in a similar manner, a strong current was obtained from the cold to the hot platinum wire, as if a loose contact had been made between two iron wires.

I do not yet know positively what the substances are which, interposed between silver and platinum and gold wires, give rise to the loose-contact currents, but I feel no doubt that these are as much thermo-electric currents as those given by the oxides of copper and iron, and are produced in a circuit composed of the metal and a very thin hot film, of which the two surfaces are unequally heated.

There are, however, some good reasons for doubting whether electrolytes can be included in a true thermo-electric series, and I consulted many authorities with reference to this point. Seebeck himself includes many electrolytes in his thermo-electric scale, and places acids below bismuth, a result confirmed lately by Gore (in 1857); he also places certain salts above antimony, a result subsequently confirmed by Andrews of Belfast in 1837. This gentleman observed that the tension produced by the salts between the wires was about equal to that between a platinum and silver plate in dilute sulphuric acid, and that the metals used as electrodes did not influence the deflection. He considered the current certainly due to a thermo-electric action.

Faraday in 1833 discovered what Becquerel subsequently called pyro-electric currents; the currents were in different directions with different substances used, and some, if not all, were of the same nature as those I have described. Leroux and Buff obtained currents where glass acted as the electrolyte. Leroux considered them thermo-electric, and Buff chemical effects. Buff also attributes some of the electrical phenomena connected with flame to a thermo-electric action in which unequally heated air or gas forms part of the circuit. The currents obtained when a hot and cold platinum wire are dipped into dilute sulphuric acid and other liquids are well known; and finally (in 1858), Mr. Wild published a laborious research, in which he seems to prove the development of thermo-electric currents not only at the junction between metals and various solutions, but also between two different solutions. Thus, although none of the above observers seem to have tested the oxides, there seems little reason to doubt that they may be classed with other electrolytes, and may give rise to currents in the same manner. On the other hand, I cannot yet consider it definitively proved that any of the currents obtained from electrolytes are due to a true thermo-electric action—that is to say, to an absorption of heat only, especially as Mr. Wild could find no trace of the Peltier heating and cooling effect at the junctions of his solutions. Further research, showing the source of the power developed, is most desirable.

While consulting the literature connected with this subject, I found that Gaugain had to some extent preceded me in the discovery of the loose-contact currents, in a paper published in the *Comptes Rendus*, in 1853. He comes to the same conclusion as I had done independently, that they were due to the unequally heated film of foreign matter, and places oxide of iron below platinum, and oxide of copper above gold and zinc, but below iron, instead of very much above it as I find. He does not appear to have observed the exceedingly high electromotive force to be obtained from these bodies, no doubt owing to the use of a short galvanometer coil of thick wires, such as is commonly used for thermo-electric researches. He introduces a carburet of iron, of which I find no trace, with more positive properties than oxide of copper, to explain some of his results. He gives very few data on which to found his theory, but simply mentions his conclusions, and appears to have made no direct experiment whatever with the oxides. Owing to these circumstances his experiments seem to have attracted little attention. I have endeavoured to contrive a convenient apparatus by which to study the properties of the oxides, but have not hitherto met with much success, owing to the great difficulty in maintaining a constant difference of temperature between the surfaces of the very thin film, which can alone be used with success. Next year I hope to obtain further results in elucidation of these quasi thermo-electric currents from electrolytes.

I now wish to add a few remarks on the currents which occur when true metallic contact is made between a hot and cold end of a wire of one metal. The existence of these currents was placed beyond all doubt by Magnus's careful experiments, but their connection with other thermo-electric phenomena has hitherto remained entirely without explanation. Wild has suggested that they might be due to a thermo-electric couple formed with hot air or gas at the moment of junction; but experiments which I have made show this explanation to be founded on a mistaken conception of the duration of the current, which is by no means instantaneous, but lasts at least five minutes with copper or with iron wires, very gradually decreasing in intensity from a maximum to zero.

Another explanation, viz. that the deflection is due to a sort of discharge of a statical effect produced by the unequal distribution of heat, is also negatived by the same consideration, as well as by the fact that a tension of sufficient magnitude to produce such a charge could not possibly have escaped observation by direct measurement.

Professor W. Thomson has shown conclusively, in his *Dynamic Theory of Heat*, that if the condition of metal at a certain temperature depended exclusively on that temperature, no distribution or movement of heat could possibly give rise to a current of electricity in a circuit of one metal; nevertheless I find, as above stated, that in a circuit of one metal wire a current is maintained for five minutes at a time, gradually vanishing to nothing when the two ends of the homogeneous wire have been for some time in contact, but recommencing if one wire is cooled for a minute and then again applied to the hot one. One explanation of this might be that the condition of the wires does not solely depend on their temperature, but is influenced to a considerable extent by the time during which they have remained at that temperature. Nor is this a gratuitous assumption: Dr. Matthiessen has proved that wires of several metals do not attain a constant *conducting* power until they have been kept for some time at a constant temperature; he finds that the conducting power of bismuth increases, while that of tellurium decreases when kept for a time at 100°. Quite similarly, some metals may rise and some may fall in the thermo-electric scale after being heated for some time, a supposition which is necessary to account for the metallic contact currents by the theory I suggest.

Another possible explanation of the metallic contact currents may be found in a partial hardening on the one side and annealing on the other, caused by the sudden contact of the hot and cold metal. If this be so, the current between annealed and unannealed wires of the same metal would correspond with the contact current between two homogeneous wires, in a way which it does not seem to do.

I am, however, now engaged in investigating this subject, and hope before next year to be able to give facts which may decide whether either of these theories is tenable. There is great difficulty in forming any conclusion from experiments hitherto made, inasmuch as none of the observers, except Dr. Matthiessen, have used chemically pure metal, and it is found that the electrical properties of a metal are affected to an extraordinary degree by the presence of impurities in very small quantities.

CORRESPONDENCE.

TELEGRAPHIC FAC-SIMILES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—"Veritas" claims for Mr. Alexander Bain the merit of being the inventor of the system of telegraphing introduced by Bakewell and others. Mr. Bain was unquestionably a most ingenious mechanician; but was he the inventor of the electro-chemical telegraph upon which is based Bakewell, Bonelli, Casselli, and others? In 1840 it appears that a Mr. R. Smith, of Blackford, Scotland, invented an electro-chemical telegraph similar in every respect to that subsequently patented by Mr. Alexander Bain. In Mr. Smith's instrument a strip of cloth, saturated with a solution of ferrocyanate of potash, &c., was made to pass over a brass roller put in motion by clockwork. When the apparatus was ready for signalling, the pressing down of the key formed the connection, and a blue mark was printed upon the cloth, by the electric fluid decomposing the ferrocyanate of potash, communication being carried on by a series of dots and lines. The electro-chemical telegraph of Mr. Bain was in extensive use both in England and America at one time, but is now almost entirely superseded by the Morse intrument, and I believe that the Morse must sooner or later give way to the Hughes and the Bonelli instruments, from the great rapidity by which communication can be transmitted by means of those instruments.

Scotia. I am, &c., ALEXANDER.

THE ATLANTIC TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The determination of the Atlantic Telegraph Company to carry out the great project, in the success of which the civilized world is so deeply concerned, cannot be too highly applauded. I trust that now, as the determination is formed, and that the cable is in course of manufacture, we shall have a truce between rival contractors and patentees. Telegraphy has suffered grievously from the discordant elements by which it has too long been surrounded and trammelled. Let us hope now that "good times are coming." There is a wide field for enterprise. We shall require many Atlantic cables to supply the commercial requirements of the vast continents sought to be united; therefore, let obstructive rivalry cease. There is ample room for all. A LOVER OF PROGRESS.

TELEGRAPHING WITHOUT WIRES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In the *Telegraphic Journal* of the 14th of March, in reply to your correspondent, "A Reader," a quotation is inserted from the specification of a patent granted to Mr. Haworth for a mode of telegraphing without wires. The subject has been often brought before the public during the last two years, and has even, if I am correctly informed, created quite a sensation amongst those whose good fortune it is to have the control of the national purse, and who, believing in the practicability of the invention, have declined to render any assistance to the great project of an Atlantic telegraph, which is now in a fair way of being realized, thanks to the liberality and discernment of an enterprising public. It appears to me incomprehensible, after the achievements attained as alleged in the specification, that no further progress has been made to render the discovery available for the purpose of telegraphic communication. Surely an apparatus capable of transmitting messages between Notting Hill and Bangor in North Wales, would be most advantageously employed, as the rapid extension of the expensive old system proves that the community fully appreciates the benefits of instantaneous means of communication. As there are numerous projects on foot for extending the advantages of international telegraphy, I hope that Mr. Haworth and his friends will no longer keep back, as it were, so valuable a discovery, but that steps will be taken at once to put it to a practical test in the presence of competent persons. Many efforts have been made from time to time to communicate by electricity without the aid of metallic conductors, but without any practical results, and I am afraid that in the present instance it will be "hope deferred," which "maketh the heart sick." Yours, &c.,

A. M. P——L.

BRITANNIA RULING THE WAVES.—This extraordinary feat may be witnessed any day by repairing to any of our submarine telegraph offices, when the whole process of ruling will be shown to the stranger. At present Britannia only rules the waves with a few lines; but in a short time it is expected she will become so perfect as to rule it with some hundreds of lines. In fact, it is considered that the ocean eventually will be nothing but an immense copybook which Britannia will be continually ruling, the better to enable historians to write her proud achievements upon it, as well as assist her in corresponding with other nations in all the gentle terms of peace and fellowship. May science, as in this instance, guide Britannia's hand in ruling the waves!

TELEGRAPHIC NEWS.

Government Returns.—In the miscellaneous estimates for last year there is an item of £280 for the erection of a line of telegraph to Balmoral.

New Public Enterprises.—We are pleased to find that the shares of the Bonelli Electric Telegraph Company and Silver's India Rubber and Telegraphic Cable Company are already at 1½ to 2 premium.

Indo-European Telegraph.—The last steamers of the Persian Gulf telegraph expedition have left Bombay for Cape Mussendum.

Bonelli Telegraph Company.—We are glad to understand that D. J. Jaffé, Esq., of Belfast and Hamburg, has joined the Board of Directors of the Bonelli Telegraph Company. We believe that the Company will be in a position to commence business, at latest within six months from the present day, between the principal towns in England.

Toulon and Ajaccio Submarine Cable.—Advices from Toulon of the 2nd inst. state that, in consequence of the impossibility of repairing the submarine cable between Toulon and Ajaccio, it is intended to undertake the laying of a cable between Nice and Calvi.

Gisborne's Signalling Apparatus.—We quote the following from the *Times*, of the 4th instant:—The Lords of the Admiralty have given directions for Gisborne's electric engine-room telegraph to be fitted on board the iron frigate Achilles, at Chatham, the report of the working of the apparatus on board the Royal Oak, in which vessel it was fitted, having been exceedingly satisfactory. The inventor is also to fix a mechanical telegraph from the engine-room platform to each of the stoke-holes.

Telegraph Engineering.—Those of our readers who are in the habit of travelling on the North London Railway between Fenchurch-street and Chalk Farm must have observed with pleasure the new standards and insulators and wires recently erected along a portion of that line. The standards have a very handsome appearance, and are painted in a light and cheerful green, and the insulating arrangements are of superior description; in every respect the work has been admirably executed.

The Great Eastern and the Atlantic Cable.—The steamship Great Eastern has been taken up by Messrs. Glass, Elliot, & Co., the contractors for the Atlantic cable, for the purpose of laying it between England and America. The Great Eastern will be handed over to the contractors on the 1st of May, who from that date pay all the expenses of the steamer, including wages, victualling, insurance, &c., and when the cable is laid the proprietors of the Great Eastern are to receive £50,000 in paid up shares of the Atlantic Telegraph Company. Although Messrs. Glass, Elliot, & Co. take possession of the steamer on the 1st of May, it is not their intention to lay the cable across the Atlantic till next spring.

Telegraph Construction and Maintenance Company, Limited.—This company has been formed for the purpose of carrying on under one management the combined business of the Gutta Percha Company and that of Messrs. Glass, Elliot, & Co., and it is presumed that the union of the two establishments will be of the most beneficial description. Whilst Messrs. Glass, Elliot & Co. have had to lay the principal portion of the submarine cables, the Gutta Percha Company, on the other hand, have had the manufacture of the cores. The capital proposed is £1,000,000, in shares of £20 each, the first issue to be 37,500 shares, representing £750,000, and the board of directors is such as cannot fail to ensure perfect confidence in the undertaking. The services of Messrs. Barclay and Glass have been secured as managing directors, who will be assisted by the staff of the united establishments; and from the high reputation gained by Messrs. Glass, Elliot, & Co., and the extensive business of the Gutta Percha Company, the investment cannot fail in realizing large profits. With the consent of the Treasury, the lease of the Malta and Alexandria line, held by Messrs. Glass, Elliot, & Co., will be transferred to this company, as will also the Alexandria, Cairo, and Suez Telegraph.

Atlantic Telegraph Company.—The following communication has been addressed to the existing shareholders in the company:—"Atlantic Telegraph Company, 22, Old Broad-street, E.C., London, April 2, 1864.—Sir,—I am instructed by the directors to inform you that the submarine electric telegraph cable for connecting Europe with America during 1865 is now in course of construction under a contract with Messrs. Glass, Elliot, & Co., the particulars of which were sanctioned by the shareholders at an Extraordinary Meeting held on the 31st ult. Under that contract the Company undertake to deliver to the contractors in cash during the construction of the cable the sum of £350,000, the remainder of the cost being payable in shares and bonds of the Atlantic Telegraph Company. The 8 per cent. preferential capital subscribed for and paid upon at present is £306,000, leaving £44,000 in 8800 shares of £5 each to be taken up. In the allotment of these 8800 shares, priority will be given to existing shareholders whose applications are received at this office on or before Saturday, the 9th instant.—I am, dear sir, yours truly, Geo. Saward, *Secretary*.

The Euphrates Telegraph.—Our last notice of the laying down of the telegraphic cable which is to put England and India in communication, through the Persian Gulf, left the cable at Ras Mundanny, on the Mekran coast. The splice between the end of the piece of cable on board the Kirkham, and the beginning of that on board the Marian Moore, had just been completed, and all the vessels were ready to start again on the morning of the 6th instant, when it was discovered that one of the principal members of Colonel Stewart's staff was missing; this was Dr. Ernest Esselbach, a gentleman of great eminence in the scientific world, who had been selected for the very important office of chief superintendent of the line when completed; the circumstances under which he disappeared, and a letter which he left behind him, made it almost certain that he had committed suicide by throwing himself overboard. Two days previously he had shown sudden symptoms of mental disorder, and having conceived an unconquerable aversion to the vessel in which he was at the time, he was transferred to another, being accompanied by a friend to whom he was much attached. On the second day after his removal he seemed so much better that his friend had hopes that the deep melancholy into which he had fallen was passing off; but he was mistaken; for (as was afterwards discovered) at that very time the unfortunate man was making preparations for a sudden termination of his life, which there is no doubt took place by his own act during the night of the 5th of February. His death is a real loss to the Indo-European telegraph, for what he had already done to improve the practical application of the branch of science to which he had chiefly devoted himself was looked upon as a guarantee that, under his management, this, the most important telegraph in the world, would be the most perfect also. The steamers got up steam, and about eleven A.M. the Coromandel started ahead to show the way, followed by the Zenobia towing the Marian Moore, which paid out the cable as she went along. On the following morning the squadron was off Cape Jask, a promontory on the Persian coast of the Gulf of 'Oman. Hitherto the cable had been laid parallel to the shore, and generally in depths of which about thirty fathoms would be the mean; but at this point it had to be carried across the mouth of the Gulf of 'Oman to Ras Mussendum, a rocky promontory which runs out in a north-easterly direction from the south-east end of Arabia, and divides the Persian Gulf from that of 'Oman. As a straight line from Cape Jask to the Persian Gulf must pass across Ras Mussendum, there is, of course, a saving in carrying the telegraph wire over it, instead of round by the extremity of the promontory; but as a submarine cable is considered much safer in these wild districts than a land line, it was desirable to find the narrowest part; this is a ridge of rock, about half a mile wide, which separates Malcolm's Inlet, on the Gulf of 'Oman side, from Elphinstone Inlet, on the Persian Gulf side. Accordingly, the vessels made for the mouth of Malcolm's Inlet, the Victoria and Coromandel leading the way for the Zenobia and Marian Moore, which passed after them to the head of the inlet, both gaily dressed with flags in honour of the perfectly successful accomplishment of so much of this undertaking. Malcolm's Inlet presents most striking natural features; it is a long, deep, winding and branching indentation into a rocky coast, extending in for several miles from the sea, and ending in a spacious rocky basin, with deep water on every side, so that large ships can anchor almost within a stone's throw of the shore, while the black rocks tower above it, at some points to a height of four or five thousand feet. The Imaum of Muscat claims sovereignty over this barren region, and Colonel Disbrowne, the political resident at Muscat, had already obtained his permission for the passage of the telegraph wire across the neck of land, and the establishment of a repeating station on it; but, after all, it seems very doubtful whose territories this barren spot is in, even the inhabitants do not seem to know, some speaking of a Sheik named Ben Suggar of Rassal Keemar as their rightful ruler, while others look upon the head men of their villages as "without superiors on earth," and responsible to God alone! The Arabs soon began to flock off to the ships in very original looking boats, and became most pressing and troublesome in their familiarities, but, as it was most important to secure their good-will for the sake of the electricians, signallers, and others who were to be left on shore in charge of the repeating station, they were treated with the utmost kindness, and no effort was spared to propitiate them by presents of rice, sugar, coffee, &c. Evidently they do not understand *quid pro quo*, for when asked to assist in landing stores, pitching tents, and building one or two wooden huts, and though promised liberal payment in money or food for doing so, they showed no alacrity to close with the offer. The greater part of the stones for the station have to be conveyed by the native crews of the ships up a most difficult hill; the labour is immense, and the assistance of two or three hundred Arabs would be most valuable, but they are very slow in giving it, and when they do, they do not work with a will. The old plan of paying a few rogues well to watch the rest has succeeded perfectly hitherto, the charge of all the stores landed having been entrusted to about a dozen Arabs. Colonels Stewart, Disbrowne, and Goldsmid have all had great experience in dealing with wild tribes, and the policy they think best is to secure the good-will of the leading men, by making it their interest to treat our people well; the greatest difficulty they have is to find out who are the real chiefs, for the local politics are most intricate, and every now and then the knots into which they get are so complicated, that the sword is deemed the only means of solution; the natural result is jealousy and hatred between the nearest neighbours, a state of matters which often impedes the arrangements necessary for the success of the telegraph, and calls for the most delicate management. Provisions of all kinds are exceedingly scarce at this place, and what is worse, good water can only be obtained from a distance; these wants greatly increase the difficulties in the way of establishing a station here; indeed, nothing but the determined energy of Lieut.-Colonel Stewart, aided by Mr. Walton, with valuable assistance from all the Bombay marine vessels, could have overcome them. Colonel Stewart never spares himself any fatigue of mind or body, though his health is far from good; indeed, his

friends (and every one of the party feels the interest of a friend in him) are constantly obliged to urge upon him the necessity of sparing himself, which he is never willing to do, even though he knows the necessity. But to return to the actual laying of the cable. It went on at an average rate of about five knots an hour throughout the whole 360 miles from Guadur to Mussendum. Sir Charles Bright says that he scarcely ever before knew so long a piece laid down as this has been, without the slightest hitch or accident of any sort; the complete success of all the mechanical arrangements is almost more than could have been certainly counted upon, as this is the first time that a long stretch of cable has been paid out of ships in tow, the moving power having always hitherto been on board the same ship as the cable; in carrying out the present plan, one great desideratum was to devise a means of communication between the towed and the towing ship, and this has been most successfully accomplished by an ingenious application of the telegraphic alphabet; the plan is most simple, though it requires considerable practice in those who use it. By day, conversation is carried on merely by movements of the hand, or of a pocket-handkerchief; at night, by alternately showing and concealing a single bright light; in this manner persons in different ships can talk almost as rapidly, and quite as fully, as if standing side by side; but of course much of the success of this means of communication depends, in a case like the present, on those in the steamer being constantly on the alert for signals from the cable ship. Sir Charles Bright gives Lieutenant Carpendale and the officers of the Zenobia—the vessel which had both the cable ships in tow during the time they were paying out—very high praise for the speed and celerity with which every one of his signals was attended to. It is quite evident that the laying down of submarine cables has become a distinct branch of engineering, and that Sir Charles Bright and his staff are thorough masters of every detail. So far as the work has gone, it may be pronounced a complete success; communication between Bombay and the farthest end of the cable is uninterrupted, and much important business connected with the expedition is daily transacted through it. If things only go on as they have begun, less than three months will see messages passing, with almost electrical speed, from London to Calcutta; we say, almost, for the recent disturbances among the Arabs in Mesopotamia, when they ill used some Europeans connected with the work, will probably render it necessary, for a time, to employ messengers across part of that district, though there is every reason to hope that next year all difficulties, even in that wild region, may be got over by negotiation. When the Bombay marine steamer Victoria left, Colonel Stewart with his staff, Sir Charles Bright, and Colonel Goldsmid, were just about making a hurried trip in the Coromandel to Bushire and Bussorah, to make arrangements for the stations to be established at those points, and to facilitate the arrangements in Mesopotamia. By the time they return to Mussendum, they will probably find the Tweed and Assaye with further sections of the cable awaiting them. If so, and the weather be even tolerably favourable, ten days would see the end of the cable in the Euphrates.—*Times of India, 14th March.*

MISCELLANEA.

THE EARLY DAYS OF TELEGRAPHY.—One of the most striking proofs of the power of the telegraph was given, almost in its infancy, by the capture of the murderer Tawell; and as it is so graphically described by the talented author of the *Bubbles from the Brunnens of Nassau*, in an interesting and instructive work styled *Stokers and Pokers*, we cannot do better than transcribe it here:—"He never expected that! He had made up his mind to give her the stuff—he had deliberately bought it—had paid for it—had put it into his pocket—had driven with it to the terminus of the Great Western Railway—had flown with it along the line to Slough—had walked with it to the cottage. He had already deprived the poor creature of her character, and now, on the first day of the year 1845, he had come down to her on purpose to deprive her of her life. With affected kindness he had offered her refreshment—had waited while, with his money, she went to buy it—he had summoned up courage?—no, cowardice and wickedness enough, secretly to pour the stuff from a tiny phial into her glass—he had seen her, with feelings of gratitude to him, raise the mixture to her faded lips—he had watched her swallow the first mouthful—then another—then drink. He had expected every instant, as she reached the drugs, to see his degraded victim drop down dead before his eyes; he could bear all this, but he did not know that it was the nature of the horrid poison he had purchased to betray the hand that administered it. Oh! he never expected that loud, horrid, piercing convulsive scream! As, terrified and scared, he opened the door to escape, the inhabitants of the neighbouring cottages, alarmed by the frightful noise they had just heard, sympathetically opened theirs. They saw him leave the house with hurried steps, observed him make for the Slough-road, where, by another party, he was observed to be 'confused, to tremble, and, on being addressed, to make no reply.' And yet he had only done what he had deliberately intended to perpetrate. He knew there was no rest for the wicked, but, oh! he had never expected that shrill, fearful haunting scream! On reaching the station, he took his place in a departing train, and in a few minutes he had, apparently, effected his escape. Everybody who has travelled by the Great Western Railway knows how joyously its well-appointed trains skim along the level country between Slough and London. He no doubt appreciated the speed, valued the wings with which he was flying more than any of his fellow-passengers. He probably felt that no power on earth could overtake him, and that if he could but dive into the mass of population in London, he would, in perfect security, flow with its streams unnoticed. But whatever may have been his fears, his hopes, his fancies, or his thoughts, there suddenly flashed along the wires of the Electric Telegraph, which were beside him, the following words:—'A murder has just been committed at Salthill, and the suspected murderer was seen to take a first-class ticket for London, by the train which left Slough at 7.42 p.m. He is in the garb of a quaker, with a brown great coat on, which reaches nearly down to his feet. He is in the last compartment of the second first-class carriage.' And yet, fast as these words flew like lightning past him, the information conveyed in them, with all its details, as well as every secret thought that had preceded them, had already consecutively flown millions of times faster; indeed, at the very instant that, within the walls of the little cottage at Slough, there had been uttered that dreadful scream, it had simultaneously reached the judgment-seat of Heaven! On arriving at the Paddington Station, after mingling with the crowd for some moments, he got into an omnibus, and as it rumbled along, taking up one passenger and putting down another, he probably felt that his identity was every minute becoming confused and confounded, by the interchange of fellow-passengers for strangers, that was constantly taking place. But all the while he was thinking, the cad of the omnibus, a policeman in disguise, knew that he held his victim like a rat in a cage. Without, however, apparently taking the slightest notice of him, he took one sixpence, gave change for a shilling, handed out this lady, stuffed in that one, until, arriving at the Bank, the guilty man, stooping as he walked towards the carriage door, descended the steps, paid his fare, crossed over to the Duke of Wellington's statue, where, pausing for a few moments, anxiously to gaze around him, he proceeded to the Jerusalem coffee-house, thence over London-bridge to the Leopard coffee-house, in the Borough, and finally, to a lodging house in Scott's-yard, Cannon-street. He probably fancied that by making so many turns and doubles, he had not only effectually puzzled all pursuit, but that his appearance at so many coffee-houses would assist him, if necessary, in proving an alibi; but, whatever may have been his motives or thoughts, he had scarcely entered the lodging when the policeman,—who, like a wolf, had followed him every step of the way,—opening his door, very calmly said to him,—the words, no doubt, were infinitely more appalling to him even than the scream which had been haunting him, 'Hav'n't you just come from Slough?' The monosyllable 'No,' confusedly uttered in reply, substantiated his guilt. The policeman made him his prisoner,—he was thrown into jail,—tried,—found guilty of wilful murder, and—hanged! A few months afterwards we happened to be travelling by rail from Paddington to Slough, in a carriage filled with people, all strangers to each other. Like English travellers, they were all mute. For nearly fifteen miles no one had uttered a single word, until a short-bodied, short-necked, short-nosed, exceedingly respectable-looking man, in the corner, fixing his eyes on the apparently fleeting posts and rails of the Electric Telegraph, significantly nodded to us as he muttered aloud, 'Them's the cords that hung John Tawell.'"

THE JOINT STOCK COMPANIES' ASSOCIATION (LIMITED), in 10,000 shares of £5 each, has just been projected. The object of this association is to organise and assist in bringing before the public, *bonâ fide* joint stock companies, the association receiving reasonable remuneration for so doing, whilst all schemes of a doubtful character as to their ultimate success will be carefully excluded. The delay attendant upon the formation of joint stock companies by private individuals will be avoided, the costs materially diminished, and a greater certainty of success attained. The company offer to undertake the duties of secretary, managers, and auditors of accounts, and provide office accommodation where it is needed, from which portion of their business they expect to derive considerable income. In the present *furore* for joint stock companies, many of which are of a very doubtful character, the guarantee of an association of this description, as to the soundness of the schemes brought forward, is very desirable; and when we see such names as Lord Henry Gordon, as chairman of the board, and Lord Kinsale as deputy-chairman, we cannot be far wrong in recommending the association to the notice of capitalists. We also notice the name of S. R. Bennett, Esq., of Nicholas-lane, on the direction, a gentleman whose large experience in matters of that description tends to give confidence in the efficient working of the company. A deposit of 10s. is to be paid upon application, and 10s. upon allotment, and no further call is expected to be required, and none is to be made within three months.

A POPULAR FALLACY.—It is a common error to suppose that birds are often killed by settling on the wires, and accounted for by the idea that they are struck down by the electric fluid passing through them. This is not possible, unless they touch two wires, and thus form a connecting medium, through which the electric current might pass. As they simply settle on the wire, the current continues on its way, preferring the metallic medium to that offered by the body of a bird. But if a bird had one leg on the wire and the other upon the ground, the electric fluid might be arrested in its course, and pass, through the body of the bird, into the ground; it is well known, and has been before mentioned, that electricity invariably takes the shortest route it can find, and it is, therefore, only reasonable to suppose that it would do so in the instance under consideration. In such a case,

if the electric current was of a sufficiently powerful nature, death would doubtless ensue, and the bird would present the appearance of having been killed by a stroke of lightning. Such an event is, however, not known in Great Britain, owing possibly to the fact that none of our birds possess legs eighteen feet long!—*Dodwell's Handbook.*

Character.—The crown and glory of life is character. It is the noblest possession of a man, constituting a rank in itself, and an estate in the general good-will; dignifying every station, and exalting every position in society. It exercises a greater power than wealth, and secures all the honour without the jealousies of fame. It carries with it an influence which always tells, for it is the result of proved honour, rectitude, and consistency—qualities which, perhaps more than any other, command the general confidence and respect of mankind. Character is human nature in its best form. It is moral order embodied in the individual. Men of character are not only the conscience of society, but in every well-governed State they are its best motive power; for it is moral qualities in the main which rule the world. Even in war, Napoleon said the moral is to the physical as ten to one. The strength, the industry, and the civilization of nations—all depend upon individual character; and the very foundations of civil security rest upon it. Laws and institutions are but its outgrowth. In the just balance of nature, individuals, and nations, and races, will obtain just as much as they deserve, and no more. And as effect finds its cause, so surely does quality of character amongst a people produce its befitting results.

Perseverance.—Much will be done if we but try. Nobody knows what he can do until he has tried; and few try their best until they have been forced to do it. "*If* I could do such and such a thing," sighs the desponding youth. But he will never *do*, if he only wishes. The desire must ripen into purpose and effort; and one energetic attempt is worth a thousand aspirations. Purposes, like eggs, unless they be hatched into action, will run into rottenness. It is these thorny "ifs"—the mutterings of impotence and despair—which so often hedge round the field of possibility, and prevent anything being done, or even attempted. "A difficulty," says Lord Lyndhurst, "is a thing to be overcome;" grapple with it at once; facility will come with practice, and strength and fortitude with repeated effort. Thus the mind and character may be trained to an almost perfect discipline, to enable it to move with grace, spirit, and liberty, almost incomprehensible to those who have not passed through a similar experience.

Secrecy of Telegraphic Communications.—Although the electric telegraph has been in successful operation in this country for sixteen years, scarcely an instance is on record where the secrecy of a despatch has been violated. This is owing mainly to the high sense of honour which every operator feels upon this point, there being no oath of secrecy required, and no laws for the punishment of its violation; but there is another circumstance which, as experience has made manifest, has given security to the public on this point. It appears that the operators who are for many hours labouring at the instrument in the transmission of despatches, word by word, rarely are able to give that kind of attention to the sense and purport of the whole which would be necessary to the clear understanding of it. Their attention is engrossed exclusively in the manipulation necessary to transmit letter after letter, and they have neither time nor attention to spare for the subject of the whole despatch. The case is very analogous to that of compositors in a printing-office, who, as is well known, may go through their work mechanically, without giving the least attention to the subject.—*Prescott.*

Jointing India-Rubber and Percha.—The weakest portion of every piece of "covered work" is the joints. The following are the instructions given by the Gutta-Percha Company:—"Have in readiness a few strips, about ⅝ inch broad, of very thin gutta-percha sheet, also a little warm gutta-percha, about ⅛ inch thick, one or two hot tools, and a spirit lamp. Remove the gutta-percha covering from along the wire no further than may be necessary for making the joint in the wire. Having joined the wire, warm gently with the spirit lamp the bare wire and joint, and the gutta-percha near to it. Taper the gutta-percha over the bare wire until the ends meet; warm this and immediately apply one of the strips of thin sheet in a spiral direction over it. Press this covering well on until cool, then, with the spirit lamp, carefully warm the surface and proceed as before to put on a second strip of the thin sheet, observing to wrap it in a direction reverse from the first strip, always making the commencement and termination of these coverings to overwrap the previous one. It is safer to perform this operation a third time. Next, take a piece of the warm ⅛ inch sheet and cover over the coats of thin sheet, again overwrapping the original covering of gutta-percha, which should be heated so as to ensure perfect adhesion. Press it well on as it cools, and when cold, or nearly so, finish off the joint with a warm tool, working well together the old and new material at each end. Lastly, and in general, avoid moisture, grease, or dirt, and be careful not to burn the gutta-percha, which would prevent proper adhesion. It is well to clean and soften the surface of the percha with rectified coal naptha. Cleanliness is most essential to success. The fingers should be used as little as possible, and must be kept very clean. The kneading and finishing the joint should be performed with the tools provided for that purpose. Moisture, tar, dirt, and grease, are fatal to a joint. The thin strips must be kept clean and dry in a small box." Rubber joints are made in the same way as percha, except that heat is not used, and that the strips are well moistened with rectified coal naphtha. It is well to cover percha joints with a layer of rubber. No one but the lineman in charge of the work, who will have the trouble of repairing it if defective, should be entrusted with the delicate operation of making joints.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine mixed, first and second qualities	2/8 to 2/6	per lb.
Good re-boiled	1/7 to 1/10	„

India Rubber.

Para, first quality	1/10 to 1/11	„
second „	1/7 to 1/8	„
third Negro-head	1/2 to 1/3	„
Java and Penang	1/4 to 1/5	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph	100	97 to 100	—
100	Submarine Telegraph, scrip.	all	48 to 53	—
all	Do. registered	all	½ to 1	—
5	United Kingdom Telegraph	3	1 dis. to par	—
10	Mediterranean Extension Tel.	all	3 to 4	—
5	London District Telegraph Co.	all	1 to 2	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

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THE TELEGRAPHIC JOURNAL.

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ON THE APPLICATION OF ELECTRICITY TO DOMESTIC PURPOSES.

By WILLIAM HENRY PREECE, Assoc. Inst. C.E.

THE application of electricity to all kinds of national, public, and social purposes, has rendered it one of the most interesting and useful studies of the day. It is used not only to transmit our thoughts and wishes to distant lands, but to guide our ships through the stormy ocean, to protect our lives in the whirling train, to beautify our table utensils, to ornament our articles of daily use, to copy our finest engravings, to illuminate our light-houses, to alleviate pain and to cure disease; and now it promises to become one of the most useful additions to the comfort and proper regulation of our hearths and homes. The domestic electric bell has every appearance of becoming generally adopted. It is so cheap and so perfect, so easily regulated, and so simply fixed. It obviates the evils of the existing system, and introduces points of great originality and advantage. Its merits have but to be known to secure its speedy adoption. It is intended in the following paper to draw a comparison between the present domestic and the electric bell, to enunciate the principles upon which the latter is based, and to describe its construction and working.

The use of bells for the purpose of attracting attention is of very ancient date. We find them in use amongst the early Jews, Greeks, Romans, and Christians. But they were chiefly employed for religious and military purposes,—suspended in churches, temples, or monasteries, to summon devotees to their religious ceremonies, or elevated in camps and frontier towns to alarm the garrison in cases of surprise or attack. The hour of bathing among the Romans was announced by a bell, and it was fastened to the necks of cattle that they might be traced when they strayed—a practice in vogue even at the present day. The Jewish priests were directed by Moses to employ them fixed to their robes.

Their employment for domestic purposes is, however, of more modern date. Subsequent to their introduction, in all large houses a domestic was in constant attendance near the principal sitting-room, whose attention was called by a clap of the hand, a stamp of the foot, or by one of the well-known Shakespearian calls:—

"What ho!"—"Without there!" or "Who waits?"

The use of the hand is still practised in the East to attract the attention of the attendant slave, but in civilised countries the modern bell has superseded all other contrivances. The first form which the domestic bell took was that of a small circular bell, or metal disc, fitted on a tall, ornamental leg, and placed upon the table. It was sounded by striking it with a piece of hard wood, cane, or metal. The ordinary hand-bell, with the moveable clapper, which is so well known in the hands of the muffin-man, was subsequently introduced. A hand-bell is still frequently in use in offices and occasional quarters, which is sounded by the pressure of the hand; a knob is depressed, which releases a spring, that drives a hammer with much force against the bell. The hand-bell, however, still necessitated the attendance of a servant, as its sound could not reach the servants' hall or butler's pantry. A great advancement was, however, made in the introduction of the bell-pull. By means of wire cranks and levers, bells could be fixed in any part of the house, and be rung from any room. Such bells are now in general use. The peer's palace and the poor man's cottage are equally supplied with them. They are as much an article of household use as a fireplace or a table. A few yards of copper wire, led underneath the flooring, through the ceiling, down the walls, and along the passage, with two or three cranks to convert the straight pull into any altered direction, and a bell can be sounded anywhere.

There is, however, a limit to the distance at which a bell can be rung. If it be too far off the strain required is such that the wire stretches and becomes useless. Again, passing underneath floors, and through exposed crannies, the cranks become clothed with dust and dirt, and therefore stick. Being constantly under a strain, the wire is not only liable to elongate, but the fixed parts and plugs are constantly liable to shift. So many parts of the apparatus are moveable. Rats and mice heap up dirt over the instable parts of the wire, and render them fixtures. We all know the disagreeable sound made in one room by the ringing of a bell in the next, and in a small house when a bell-handle is even gently pulled this grating sound is heard in every other room. Each particular room requires a different toned bell to distinguish it, and it becomes a great tax upon a servant's memory, particularly if she have not a musical ear, to recollect all the different notes. This evil is to some extent remedied by supplying the bells with levers, which continue to rock for some time after the bell has ceased to ring; this, however, at best, is but a clumsy contrivance. Indeed, every householder knows that, as at present constructed, bells are a constant source of trouble. The larger the house the more is this experienced, and in some of our palatial residences the bell-hanger is never out of the house.

It is evident, therefore, that some improvement is needed in the construction and working of our household bells. The chief cause of the inconvenience we suffer lies in the fact that we have to exert a strain upon the wire to produce a sound upon the bell. Remove the necessity of pulling the wire, the wire remains firm, the noise ceases, the cranks are abandoned, and it matters not how much dirt vermin heap over the wire—they can't eat it. All these evils—unpleasant noise, liability to stick, proneness to stretching, instability of parts, variation in tones—are entirely removed in the new electric bell, which is so extensively employed in France. Nothing struck me, in a recent journey to Paris, so much as the extensive use which our neighbours make of this new application of that wonderful science which serves our public and private wants to such a marvellous extent. Electric bells are used everywhere—in private houses, in public institutions, in merchants' offices, in ordinary shops, in cafés, and restaurants; all the large hotels—the Grand Hotel, the Louvre—are most completely provided with them; indeed, they have become a general domestic necessity. Enormous posters, as extensive as those of "Bel Demonio," "Leah," or "Miles' cheap trousers," upon our metropolitan walls, advertise them to the Parisian public. Large shops are devoted to their supply alone. They must, sooner or later, be introduced into England, for we can't long remain behind our neighbours across the water in an article of such advanced principles and of such domestic and every-day use.

A gentle pressure upon a small button effects all that is required. The electric force that rings the bell steals noiselessly along the wire, there is no sound, there is no strain; but the bell gives forth its warning sound as though it were rung by the stout arm of some invisible sprite.

How is this effected? We require a *battery* to generate the electric force, *wires* to convey it to the bells, *buttons* to bring it into play, *bells* to be sounded, and *tablets* to indicate the room from whence the impulse emanated. Let us consider them in order:—

1. *The Battery.*—The electricity employed is that usually termed "voltaic electricity;" it is the result of chemical decomposition, and is produced by the action of a galvanic battery. If we take a strip of zinc, Z (Fig. 1), and a piece of copper, C,

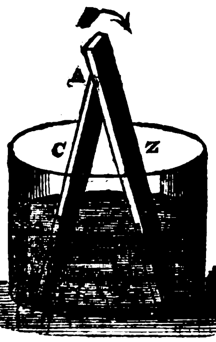

Fig. 1.

and place them in a vessel containing water, so that the submerged portions may be separated, whilst the upper parts rest against each other, we have a simple battery. The oxygen of the water attacks the zinc, chemical decomposition sets in, and a current of electricity is generated. This happens when the upper parts of the metals are placed in contact, but the moment they are separated all electrical action ceases. It matters not whether the metals are brought into immediate contact; a piece of wire connecting them would have the same effect. Such a battery as the above is of very weak and momentary power. The zinc becomes coated with oxide of zinc, which is insoluble in water, and stops all chemical action, and therefore all electrical generation. A little sulphuric acid, however, added to the water, obviates this by converting the oxide of zinc into sulphate of zinc, which is soluble in water, leaving the zinc clean, and allowing the chemical action to continue. As long, therefore, as there remains any zinc to be eaten away, and any sulphuric acid to unite with the oxide formed, a current will continue to flow until the solution becomes saturated with sulphate of zinc, when, by a peculiar electrical process, the metal zinc becomes deposited upon the copper plate, and stops all further action. To obviate this it is usual to place the zinc in a solution of sulphate of zinc, and the copper in a solution of sulphate of copper, separating the two by a porous earthenware partition, in which case copper, instead of zinc, is deposited upon the copper plate, which, of course, does not interfere with the generation of electricity.* Such a battery as this, with only one pair of plates, possesses but small power; it can only work through a very short distance, and gives but a feeble sound upon a bell. Any addition to the length of the connecting wire tends to reduce its power, but by increasing the number and size of the cells we can make it of sufficient strength to sound the loudest bell through the greatest distance.

Thus, let us take another vessel, with another pair of plates, similar to those employed in Fig. 1, and let the vessel be charged as in the previous experiment. Connect the zinc (Z) of the one to the copper (C) of the other by aid of the copper wires (A B), as in Fig 2. We now obtain a battery of double the power of

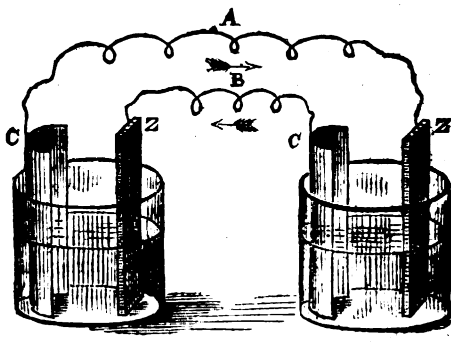

Fig. 2.

that in Fig. 1. By adding another cell, charged, and connected in the same way, we again increase the power, and so on by every additional cell we obtain additional power. The copper end (C) is called the positive (+), and the zinc end (Z) the negative (—) pole of the battery.

So long as the cells are connected by the wires A and B, the current generated will continue to flow as indicated by the arrows; but if the wire be broken or disconnected, or one of the plates be withdrawn, the current will cease. The wire, or "circuit," as it is technically termed, must be complete and unbroken before a current can pass. The current is always supposed to flow from the zinc through the liquid to the copper, and thence by means of the connecting wires back to the zinc. This flowing of the current is simply an arbitrary method of conceiving its action, and though probably not theoretically correct, it is practically the most useful method of describing the force generated by the battery. It does not imply the actual passage of any fluid or gas, but a simple transfer of force: an action which is progressive in its nature, like the passage of light through space, sound through air, or heat through a rod of metal.

As it would be excessively inconvenient, in practice, to employ a number of cells, as before described, to overcome the effects of resistance,* a more compact and convenient battery has been designed. It is a trough, made of teak, divided into a number of compartments, each compartment or cell answering the purpose of the vessel employed by us in Figs. 1 and 2. These cells, which are made water-tight with a lining of marine glue, are again divided by porous partitions, so as to keep the copper solution separated from that of the zinc. A plan of the battery in question is shown in Fig. 4. It is called a 12-plate *sulphate* battery, there being sufficient cells to accommodate twelve pairs of battery plates. It is charged by filling the zinc cell with water, or a weak solution of sulphate of zinc, and the copper cell with a solution of sulphate of copper, or with water and crystals of sulphate of copper. When the plates are laid in as shown, and the two poles C Z connected, we have battery power of sufficient influence to ring any bell that may be required for domestic purposes. The porous cells are shown as fixtures, but they are sometimes made moveable. Such a battery will retain its power for a considerable time without attention—ordinarily from six to eight months. It will then however give symptoms of impaired power.

The failure, or diminished action of the battery, is at once

* There are several secondary actions in the battery obviated or modified by this arrangement, but I have not considered it necessary to allude to them in these few elementary remarks. They will be found fully described in electrical works. My description of the action of the battery, also, will not bear theoretical analysis, but it has the merit of being simple and easily comprehensible by those who are not deeply versed in the science.

* The *resistance* of a circuit is the opposition that it offers to the passage of a current. It increases directly with the length of wire, and inversely with its size, so that the longer the wire, and the smaller it is, the greater is the resistance which it offers to the current. Every bell offers a certain resistance. I have endeavoured to avoid the employment of technical terms as much as possible, chiefly because in the present condition of the science they are in a hopeless state of confusion. The few that I have introduced are intended to the comprehension of the subject.

detected by an increasing faintness in the ringing of the bell, and by a continued feebleness in the movements of the needles or indices that it actuates. When this is observed the battery should at once be examined and cleaned.

If a battery were constructed of pure and perfect materials its action would result in the continued formation of sulphate of zinc in the zinc cell, and in the continued consumption of sulphate of copper in the copper cell. It would, therefore, be only necessary occasionally to withdraw from the zinc cell, a portion of the sulphate of zinc, replacing it with water and to refresh the copper cell with crystals of sulphate of copper. But as materials cannot be obtained pure, several irregularities enter into the working of a battery, which interfere with its action and require investigation.

The water with which the cells of the battery are charged, if it be fixed in a dry place, evaporates, and leaves the battery dry. It must, therefore, be maintained properly supplied with water. It should never be surcharged with water. If the water reaches within an inch of the top of the battery it will be quite sufficient. A thin layer of oil upon the surface of each cell tends considerably to prevent this evaporation. It is for this reason also found preferable to place batteries in slightly moist positions.

When a battery has been for some time in action the zinc is found covered, and the zinc cell filled to a great extent with a "mud"-like substance. This mud is principally composed of pure copper, deposited upon the zinc by chemical affinity from the solution of sulphate of copper, which has permeated through the porous cell. It must be carefully removed, and retained in some receptacle appointed for the purpose, as it is commercially valuable, and tends to defray the cost of working the battery.

The porous cells are also frequently constructed of bad material they contain particles of coke or metal dust. Copper is then deposited upon them in patches. If these patches touch the zinc considerable local action sets in, wasting both zinc and sulphate of copper. When porous cells become encrusted with copper, they should at once be removed.

There is frequently a peculiar passage of liquid from the zinc to the copper cell through the porous partition, owing to a peculiar physical action called *osmose*, which raises the liquid in the copper cell an inch or more above the level of that in the zinc cell. It is assisted by the current. Its cause is not known. It usually occurs only when the battery is first set in action, and is easily corrected by the addition of a few drops of acid.

When the solution in the copper cell becomes exhausted of sulphate of copper, the sulphate of zinc, which has been formed in the zinc cell, passes through the porous partition, and deposits zinc upon the copper plate. This blackens the plate and reduces the action of the battery. Crystals of copper should, therefore, always be retained in the copper cell. They should be bruised into small lumps before being inserted in the cell, which should never be more than half filled with them.

When water contains lime (as almost all water does) part of the sulphate of copper dissolved in it is decomposed, forming a cloudy or jelly-like scum. This should be removed. It is, however, prevented from forming by adding a drop or two of acid to the water before the solution is made.

The water in the zinc cell, after continual use, becomes saturated with sulphate of zinc; this salt crystallizes upon the zinc plate, porous partition, and sides of the cell, and eventually impedes or stops the action of the battery. A portion of the solution should be occasionally withdrawn and replaced with water, and the crystals removed with a damp cloth. The formation of crystals on the porous cells is frequently checked by filling the pores of all the exposed parts with tallow, wax, or pitch, but cleanliness is the only real effective method of preventing any interference from crystallization.

After the continued action of twelve or eighteen months some of the zinc plates will be found so corroded and reduced in size as to become useless. They must be replaced with new plates.

A battery when it is first charged rarely assumes its full power until it has been at work for two or three days, but it can immediately be set in full action by the addition of a few drops of acid. This, however, interferes with its permanence, and should be avoided.

When a battery is cleaned the plates should be removed, and the divisions thoroughly rinsed and washed out; the plates well scraped and scrubbed, defective porous cells and zinc plates removed, and the battery again carefully charged.

It is an excellent plan in recharging the battery to make use

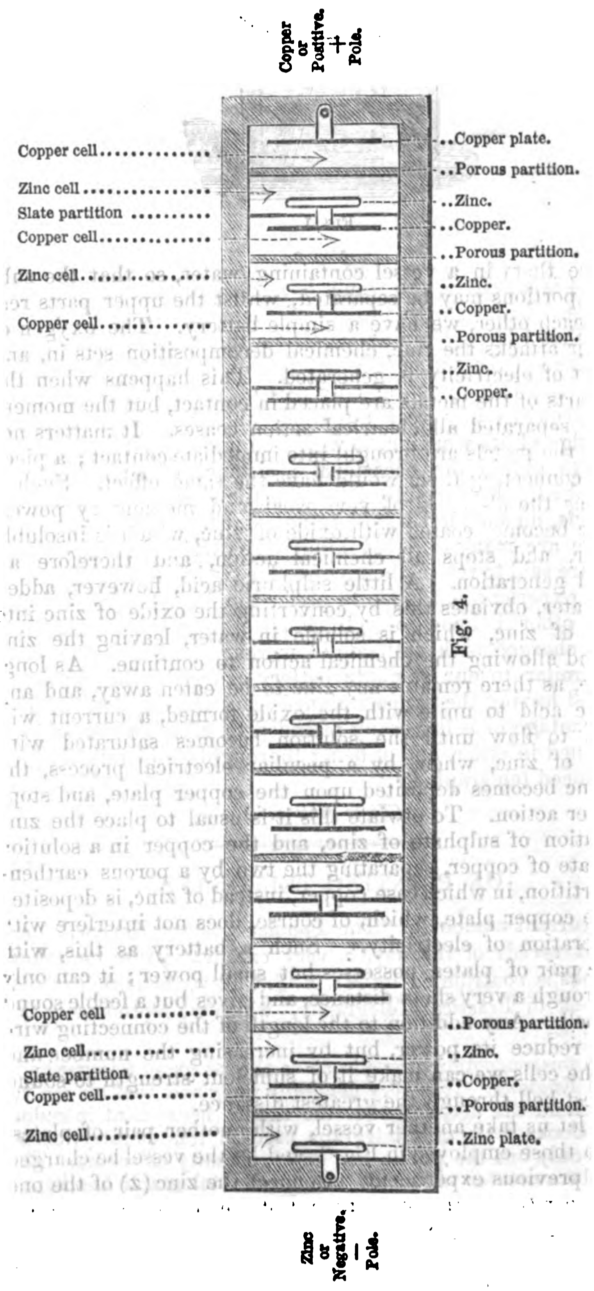

Fig. 4.

of the liquid which has been withdrawn from the zinc cells after the old plates have been removed preparatory to cleansing.

This can be done by a syphon or syringe. The liquid which has been withdrawn should be placed in a vessel containing a few pieces of zinc to reduce any copper that may remain in solution, and be reserved until the battery has been cleansed, the plates replaced, and the sulphate of copper deposited in the cells. The solution may then be distributed equally throughout the zinc cells, supplying each cell as far as the liquid will allow, and then filling up to within an inch of the top with water.

A defective cell, arising from a leakage or a broken porous partition, is sometimes found, reducing the power of the whole battery. In such a case it is a good plan to bridge it over thus—thoroughly clean the strap of the two battery plates between which the defect lies, and connect them across by a piece of wire, as illustrated in the following sketch :—

Copper. Fault. Zinc.

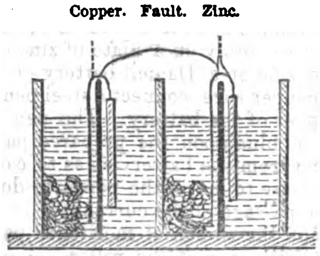

Fig. 3.

Fig. 4 is a plan of the whole battery, and Fig. 3 a section of two cells. I hope, with the aid of these two sketches, and the details that I have given above, that a thorough conception will be obtained of the action of a battery. I have been thus minute because the battery is the only part of the domestic telegraph which requires any real attention, and without a thorough knowledge of its working, it would be necessary for the householder to obtain the occasional assistance of an experienced telegraphist. By carefully following the above description and directions, no such aid would be necessary.

There are many different kinds of batteries in use, some of which are said to retain their power for twelve months or more; but my experience leads me to prefer the form I have described to any other I know of. In France they use an excellent battery charged with sulphate of mercury, and also one somewhat similar to our sulphate battery charged with sulphate of lead, and having the coppers tinned; but the one described has the advantage of being easily attended to, of being economically maintained in order, and of being thoroughly understood by our experienced telegraphists.

(To be continued.)

ON PRINTING TELEGRAPHS.

In the current number of "The Popular Science Review," one of the best serials of the day, a very excellent paper on printing telegraphs is contributed by Mr. R. S. Culley, the author of "The Handbook of Practical Telegraphy," which we reproduce in these columns :—

Much misconception prevails as to the progress telegraphy has made in England. It is very generally imagined that we are very much behind the age, and that the needle instrument introduced by Mr. Cooke is the only telegraph used in this country, because it is the only one the public has an opportunity of seeing. There cannot be a greater mistake. The needle telegraph has kept its place at our railway stations, and will keep it, perhaps, for many years, because of its simplicity, freedom from derangement, and the ease with which it can be repaired when out of order; but it is not used on any one important "commercial" circuit, even of the company which purchased the patent right.

The signals of the needle instrument, as is well known, are transient, and must be read off one by one as they appear, without a moment's hesitation. Though at the completion of each word the reader has the opportunity of saying that it is not understood, and obtaining a repetition, it may easily be imagined that if he give many "not understands," as they are called, the sender, who considers, naturally enough, nothing but stupidity prevents his signals being read, loses patience, and either reports the receiver as incompetent, or quarrels with him. Hence a tendency to guessing. These electrical quarrels are, in fact, one of the greatest sources of delay to messages, and damage to the apparatus, upon which the combatants vent their wrath as they cannot reach one another. Again, when an error arises, as it cannot be proved which clerk is to blame, it being impossible to determine whether the word has been wrongly signalled or read off inaccurately, neither the sender nor the receiver considers himself responsible. The feeling of responsibility is, however, amply secured by the printing system, for the signals are permanently recorded on the paper ribbon, or "slip," as it is technically called, and it is only necessary to refer to it to decide where the blame lies. The tendency to quarrel and talk is kept under control, for the slip, containing the whole conversation or quarrel, can be brought forward as evidence if required. And as the printed signals, if not perfectly legible at the first glance, can be studied, fewer errors occur in reading off. A far greater amount of accuracy is therefore attained by the recording apparatus than by any system of transient signals.

The simplest printing telegraph is that of Professor Morse, of America. The alphabet consists of dots and dashes, and though purely conventional, is easily learned. It has been altered from time to time, in order that accidental irregularities in the distance between the dots and dashes shall not transform one important word into another; and although England at one time possessed an alphabet better suited to our own language, it was found necessary, on the establishment of direct communication with continental cities, to fall in with the system in use abroad, and the same characters are now adopted throughout the whole of the old world.

THE MORSE ALPHABET.

A	· —	J	· — — —	S	· · ·
ä (æ)	· — · —	K	— · —	T	—
B	— · · ·	L	· — · ·	U	· · —
C	— · — ·	M	— —	ü (ue)	· · — —
D	— · ·	N	— ·	V	· · · —
E	·	O	— — —	W	· — —
F	· · — ·	ö (œ)	— — —	X	— · · —
G	— — ·	P	· — — ·	Y	— · — —
H	· · · ·	Q	— — · —	Z	— — · ·
I	· ·	R	· — ·	Ch	— — — —

The Morse apparatus has been adopted almost universally. It is sufficiently simple to be worked by any lad of ordinary capacity, does not really get out of order, and if deranged, can be set right with perfect ease. The dots and dashes, or "marks," as they are called, are embossed by a steel tracer or pencil upon a ribbon of paper, drawn forward at a uniform speed by clock-work; or written in colour upon the paper, by its being raised into contact with a small thin disk, covered with a peculiar ink. The latter arrangement produces more legible characters and requires less mechanical force than the embossing process, but needs a little more care.

The arrangement by which the electric current causes the pencil to touch and recede from the paper, so as to mark it, is this:— In the upper roller of the pair by which the paper ribbon is carried forward is a groove; under the rollers is a lever, pivoted at its centre, carrying at one end the pencil or style, and at the other end a piece of iron, which forms the *armature* of an *electro-magnet*, or horseshoe-shaped bar of iron, covered with insulated wire. This armature lies close to the electro-magnet, but does not touch it, being held back by a spring.

When a current is caused to pass through the wire, the horseshoe becomes a magnet, attracts the armature overcoming the resistance of the spring, and presses the pencil upon the paper; but as soon as the current ceases the iron loses its magnetism, and the pencil is withdrawn by the spring.

The duration of the current and length of the mark depend upon the sending-*key*. This key, in its simplest form, is merely a lever attached to the line-wire, or wire fixed from one station to the other, which, when at rest, connects the wire with the earth, but when pressed places a battery between it and the earth, so as to send a current to the distant station.

The clerk taps out his message by means of his key, producing a succession of currents which act on the electro-magnet at the distant station, attracting its armature, and embossing or printing corre-

sponding dashes and dots upon the paper band as it passes forward between the rollers, recording every movement of the sending-key.

On the conclusion of the message, if it is legible, the number of words is counted; and if correct, the receiver acknowledges it by sending back certain signals serving to identify it, followed by · — · — RT "right" (in America, O K, "all correct"). This acknowledgment appears on the slip of the sending station; and in case the message should not reach the person for whom it was intended, can be produced as a proof that it was duly transmitted.

The paper ribbon is cut in long lengths, and each roll is kept entire and unbroken, so that every signal may be registered in its proper place. If this were not done, the record would be useless as a check, for dishonest clerks would be tempted to manufacture acknowledgments, and to destroy messages which they had neglected to deliver. The unbroken record prevents any such alterations and erasures.

Much has been said of the superiority of the American telegraphists, because they are able to read the Morse signals by the sound made by the electro-magnet; and of the great saving in expense effected by dispensing with the paper slip. By this plan the advantage of the record is at once lost, and the Morse apparatus used as an acoustic instrument is not, in our opinion, either as rapid or as accurate as the bell telegraph of the Messrs. Bright. It is not from a want of ability to read by sound that the system does not prevail here, for the English staff converse among themselves by almost inaudible taps upon the table, which has the merit of being a much more correct and rapid method than that adopted by the spiritual intelligences who favour us with their conversation, but who do not seem to have made much progress in this particular department of knowledge. Our clerks also talk by a slight movement of the forefinger or thumb, imperceptible to the uninitiated, which would be a wonderful assistance to clairvoyants and conjurors. Indeed, Robert Houdin employed some such means in his celebrated "second sight" experiments.

The Americans, however, because of a peculiarity in their system, can beat us in one particular. When in the open country, they can read what is passing on a wire by cutting it and putting its two ends into the mouth, and can reply by tapping them together, without any apparatus whatsoever.

In the earlier days of telegraphy, it was impossible to obtain legible signals at distances over 200 miles, even in dry weather, and during fog or rain it was necessary to transmit messages by reading them off at an intermediate station, and forwarding them on afresh; so that a message from London to Glasgow would be repeated twice, or even four times. Owing to the great improvements in insulation, distances of 400 miles now offer no obstacle to direct communication in all weathers.

The Morse instrument has the great advantage of being capable of acting as an *automaton clerk*, and transmitting its own signals. The movement of the lever which carries the armature and style is limited by two screws, between which it oscillates with considerable force. It can, therefore, be easily made to perform the function of a key, so as to forward the message a second stage, where the same process may be again repeated.

By means of a series of such relays, direct communication is effected between London, Berlin, and St. Petersburg, or even more distant cities.

We have described the Morse apparatus in its simplest form, for the limits of our paper do not permit enlarging upon the contrivances for neutralising the effects of induction in submarine cables, for cutting off the leakage from neighbouring wires, and for increasing the sensibility of the apparatus. It is, however, necessary to mention one point. As it is not possible to transmit to a great distance a current sufficiently strong to produce a powerful mechanical action, the current received from the sending station is made to act on a relay connected with as powerful a battery as may be required to set in motion the Morse apparatus.

The speed attained by the Morse system varies with the nature of the despatch. Intelligence or news can be worked off much faster than private messages. A first-rate clerk has been known to send between sixty and seventy Stock Exchange messages per hour, but thirty to thirty-four words per minute is excellent work, the receiver, of course, writing for himself.

Owing to the facility afforded by the system of transmission by relay, or as it is called, *translation*, despatches can be sent to stations, on separate and distinct wires, at the same time by a single clerk. The debates in Parliament, Reuter's telegrams, and the other items of telegraphic news which appear in the country papers, are now frequently manifolded in this manner—to six, seven, or even more stations at the same time, and it would be quite possible, if it were desirable to do it, that a single clerk in London should supply every large town in the kingdom, at one and the same moment.

The printing telegraph first used here, and still partially employed, is, however, not that of Professor Morse, but an invention of Bain, of Edinburgh, founded on the chemical effects of electricity. When a current is caused to pass through the solution of a chemical compound, it decomposes it, or separates its component parts, in many cases producing an alteration in colour, either by causing the wire which conveys the current to be dissolved, or by separating a coloured solid substance from a solution previously colourless. Thus if a current be made to pass through paper soaked in iodide of potassium, iodine, a solid substance, will be separated at the wire connected to the copper of the battery, and a brown stain will be produced. Soak a sheet of printing-paper in a mixture of equal parts of saturated solutions of the ferrocyanide of potassium and nitrate of ammonia, diluted with an equal volume of water; blot it off and lay it smoothly on a plate of zinc or sheet of tinfoil, connected with the zinc of a Daniell battery of twenty cells. By means of a flexible copper wire, connect a steel pen fixed in a wooden holder with the copper of the battery. The pen will now be found capable of writing in blue upon the prepared paper; but if either wire be disconnected from the battery so as to cause the current to cease, the pen will cease to mark, the power to do so being entirely dependent upon the passage of the current.

In Bain's telegraph the ribbon of moistened paper is carried forward by clockwork over a metallic roller. A pencil of iron wire rests upon the paper, and is so connected that the positive current flows from the iron to the paper, producing signs similar to those of Morse.

The apparatus we have described is so simple and so easy to manage, that it will always be extensively used; nor is the peculiar alphabet as great a disadvantage as it may seem, for there is no real difficulty in acquiring a knowledge of it.

The instruments which print in ordinary letters by the pressure of inked type are extremely complex, and though, from the fact that each letter is formed by the simple pressure of a key like that of a pianoforte, it might seem they are easily worked, the fact is, so much skill is required to manage them and to print at a sufficiently high speed, that they are at present practically unremunerative. The most important instrument of this class is that of Professor Hughes, of New York. The apparatus at all the stations is precisely alike, and consists of a keyboard like that of a pianoforte, containing as many keys as there are letters, figures, and marks of punctuation to be printed. Connected with the keys is a set of moveable pins arranged vertically in a circular frame, through the centre of which passes an upright shaft, kept constantly revolving by clockwork. Hinged upon this shaft is an horizontal arm, which sweeps round continually a little above the circle of pins. If one of these pins be raised by pressing the key with which it is connected, the arm will touch it and slide over it in passing, establishing contact with a battery. A wheel on the edge of which the letters are engraved, is driven by the clockwork which keeps the horizontal arm in motion, and is so arranged that whenever the arm passes over the pin corresponding to a given letter on the keyboard, the letter itself on the type-wheel is opposite the paper. If the speed of the distant instrument can be so regulated that its type-wheel shall move in perfect accord with that of the sending station, and if the paper ribbon at both stations be pressed upon the type at the same instant, the same letter will be printed at each. The pressure necessary for printing is produced by the current sent by the contact of the horizontal arm with the raised pin, which acts upon an electro-magnet and removes a catch or detent, permitting the wheelwork to raise the paper so as to touch the type. In order to obtain sufficient speed, it is necessary that the type-wheel should revolve at least 120 times per minute; and it will easily be understood that there is great difficulty in so regulating the receiving machine that at this high velocity it shall neither lose nor gain upon the sender. The adjustment is obtained by means of a vibrating spring which acts as a pendulum, and small differences in speed are adjusted before the printing of every letter by the machine itself.

M. Dujardin is engaged in perfecting a type machine on a different principle. Want of space compels us to omit the description of this and other methods of type-printing equally ingenious.

(To be continued.)

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(Continued from page 174.)

(*d.*) *Step-by-step Type-printing Instruments.*—The only new type-printing instruments, besides that of M. Bonelli, are French step-by-step instruments, which may be conveniently described here.

Messrs. Digney, Paris (France, 1,414), exhibit a modification of the dial instrument, which converts it into a very simple type-printing instrument. They work the escapement moving the type wheel with, say, a positive current and interruptions, by means of a steel magnetized armature in front of the two poles of a double electro-magnet, which repels the armature when a positive current passes, but attracts it when no current is passing, or when a negative current arrives. At the back of the electro-magnet is another magnetized steel armature which, on the contrary, is only repelled when negative currents arrive; it is used to close the local circuit which prints the letters, and moves on the paper in the usual manner. In their transmitter, so long as the handle is turned round, positive currents only are sent, separated by short interruptions, as in M. Bréguet's step-by-step instrument; both a current and an interruption are required for each letter. These currents move the type wheel round. When the handle has arrived opposite the letter required, it is pressed down for a moment, making a contact which sends a negative current into the line, and this current, by moving the second armature, prints the letter. This instrument prints about nine words per minute.

P. A. J. Dujardin, Lille, M. (France, 1,439), exhibits a step-by-step type-printing telegraph of remarkable merit. The transmitting instrument has the disc and sinuous groove, common to all the French instruments of this class. It sends reverse currents by a very simple key moved from this groove, and is so arranged, that when the handle is depressed the current is broken. The reverse currents work a step-by-step propelment, which brings the required letter opposite the paper, and the printing is effected by the interruption of the current. The type wheel is quite novel, and it is probably to its peculiar construction that M. Dujardin owes the success of his instrument. It consists of a small flat disc made of very thin aluminium. The letters are, as it were, sewn in a circle round the face of the disc (not on its edge), a hole corresponds to each corner of the letter, and silk passing in and out defines its form. The depression of an inked pad over any one of these letters presses it on the paper, where interruption of all currents is also worthy of notice. There the silk leaves its mark, and at the same time receives a fresh charge of ink from the pad. It is difficult to imagine that any lighter and stronger type wheel could be constructed. The plan of determining the impression by the electro-magnetic coils, through all of which the received currents pass, move three cylinders of soft-iron to the left or right with positive or negative currents respectively. One of these cylinders works the escapement of the letter disc by its oscillations. The two others are so arranged that, when no current circulates through them, the right-hand cylinder is moved to the left, and the left-hand cylinder to the right, by springs. When they are both in this position they close the local circuit, which brings the pad down on the type wheel and prints a letter. The received currents pass through all the coils either in multiple arc or in series, as best suited to the circuit with which they are working.

So long as reversals are received, the three cylinders move parallel to one another, first all to the right, and then all to the left, moving the type wheel round, but leaving the pad unmoved; so soon, however, as the currents cease to pass, the type wheel and its cylinder stand still wherever they may be; the two other cylinders, instead of remaining parallel, come together, close the local circuit, and print the letter. As soon as currents begin to arrive they again take up their parallel position, breaking the local circuit, lifting the pad, and moving the paper on a step. It is worthy of remark, that by this plan the same letter can be continually repeated without moving round the sending arm by simply raising and depressing the handle. The cylinders spoken of perform the functions of the armatures in common electro-magnets. They are all similar, and consist of a long hollow cylinder of soft-iron centred on an axis perpendicular to the axis of the cylinders in the middle of their length. One half of the cylinders passes into the hollow centre of the receiving coil, and the end even passes a little beyond it. Positive and negative currents passing through the coil alternately magnetize this cylinder in one and the other direction. The two poles of a powerful horseshoe magnet are placed to the right and left of the end of the cylinder, which, as it is magnetized in one direction or the other, oscillates backwards and forwards between those poles.

This arrangement can be worked by weak currents. The instrument exhibited was worked successfully by thirty-two Daniell's cells in circuit, with Messrs. Digney's resistance coils, equivalent to 700 kilometres* of iron wire, 4 millimetres in diameter, printing about twenty words per minute; and two similar instruments worked regularly for three months between Paris and Lille, a distance of 280 kilometres, or 174 miles.

By a slight alteration in the connections the two coils, which determine the printing when their cylinders are parallel, can be made to act also as a relay to work the propelment coil, which is then, of course, not in the same circuit. They could also be used to translate reverse currents into a second line.

M. Dujardin received a medal for this instrument.

L. C. Guyot D'Arlincourt, Paris (France, 1,444), exhibits a step-by-step printing instrument of great complexity. The coercive force of soft-iron is used to determine the impression of the letters in a manner which has been frequently proposed. The momentary reversed currents which work the step-by-step propelment are of too short duration fully to magnetize a large electro-magnet, the armature of which by its motion determines the impression of a letter at each pause in the transmission, when a permanent current is transmitted.

J. W. Brett (United Kingdom, 2,853) exhibited the same printing instrument as was shown by him in 1851. It has not come into general use in this country.

In 1851 several step-by-step instruments were exhibited, the index of which returned to zero after each letter, so that a constant number of currents was required for each letter, which thus became independent of those preceding it. This apparent merit has evidently been found of little importance, for on the present occasion not one instrument of this kind is shown.

9. *Automatic Letter-printing Instrument without Step-by-step or Synchronous Motion.*

Chevalier G. Bonelli, Turin, M. (Italy, 1,227), exhibits an automatic system of transmission, which differs essentially from the four plans before described, inasmuch as the message is prepared for transmission in the ordinary Roman type, and is received or printed in the same letters. The plan resembles to some extent that of Bakewell, exhibited in 1851, but differs from it inasmuch as the synchronous motion of the instruments at the two ends of the line is dispensed with by the use of a large number of conducting wires instead of a single one. M. Bonelli, like Caselli, uses reverse currents to act on the electro-chemically-prepared paper.

M. Bonelli composes his messages in Roman type of the ordinary construction. He then passes the arranged type under a little comb with ten equally spaced teeth, which just cover the breadth of the type (which is about 0·17 inches wide). These ten teeth are all insulated from one another, and each is connected with its own line wire. Thus, ten distinct line wires are required. At the receiving station each wire is in connection with a corresponding tooth of a similar comb, which rests on the chemically-prepared paper. Each of the teeth of the sending comb as it comes in contact with the projecting portions of the type sends a current through its line wire, which is marked with the corresponding tooth by an electro-chemical reaction on the prepared paper, as it is drawn under the receiving comb at approximately the same speed as the type passes under the sending comb. In fact, each line wire with its sending and receiving tooth may be looked upon as a separate Bain's system, with one important difference, to be mentioned presently. Each line, therefore, transmits only points or strokes, but these points and strokes are so grouped as to correspond with the projecting portions of the type, so that the dots and lines from the ten wires will be distributed in groups very accurately representing the letters. With ten distinct wires or rows of dots and lines the letters are extremely well formed: M. Bonelli states that seven would be found practically sufficient.

The arrangements for sending and receiving the messages are very complete, and sufficiently simple. A sort of long car at each station is driven by a weight along rails, and its speed is regulated by a fly. Along one end of the car is placed the message in type to be sent; this message cannot greatly exceed twenty words. Along the other end of the car a piece of moist prepared paper is placed. The two cars at the two stations start at about the same

* This is equal to about [illegible] miles of No. 8 iron wire.

time; each sends and each receives a message of about twenty words during one traverse of the car. One station sends during the first half of the journey, and receives during the second half, while the other sends during the second half, and receives during the first. A fresh type-stick is then placed on each car with clean receiving paper; the cars are moved back to their original position by hand, and the operation is repeated.

M. Bonelli could not make use of Bain's chemical reaction, for this depends on the gradual consumption of an iron point, whereas it will readily be seen that M. Bonelli's little combs must remain unworn. He uses a solution of nitrate of manganese, which, under the action of a positive current, precipitates oxide of manganese. Without the discovery of this, or some similar method of marking, M. Bonelli's invention would have been impracticable.

The points of the combs are made of a platinum-iridium alloy. The sending comb can rock slightly on an axis, so as to press lightly on the type passing beneath. The receiving comb is fixed, as the moist paper beneath yields readily to the pressure. There is also a contrivance for sending reversals at each signal through each line: a positive current each time a tooth comes in contact with the type, and a negative current whenever it is insulated. This was rendered necessary by the polarization which otherwise occurred at the points of the receiving comb, where the accumulated products of the reaction from successive similar currents prevented the regular passage of the true received currents.

M. Bonelli, however, obtains these reversals at a great waste of battery power. The negative poles of the batteries at each end are permanently in connection with the lines, of which, for the moment, we will consider one only. He further arranges his connections so that the contact with the type connects the whole of the battery at the sending station with a short circuit, and at the same time supplies an earth connection to the battery at the receiving station. The positive pole of one part of this battery is connected with the earth through the receiving paper, and a positive current from that part of the battery consequently flows through the paper at the receiving station as soon as the other pole finds an earth connection at the sending station, or, in other words, whenever the type contact is made; when this contact is broken the home short circuit is also broken, and the negative current from the whole of this battery overpowers the current in the opposite direction from the smaller section at the receiving station, and so the negative current, partially neutralized, passes through that battery, and through the paper to the earth. Thus, one of M. Bonelli's currents is the result of a difference between two antagonistic batteries, and the other is only obtained from the smaller section of one battery at the expense of allowing the larger to send a current through a short circuit. The batteries, moreover, require to be powerful; each wire on a short circuit requires from fifteen to twenty cells at each end, and in practice M. Bonelli expects to use at least sixty cells per wire, or 1,200 cells with ten wires for two stations only.

The expense of first cost and maintenance would obviously be considerable. On the other hand, M. Bonelli expects to transmit 500 messages of twenty words every hour, using two cars at each of the two stations, one of each pair to receive and send while the other is being prepared. Each message of twenty words, allowing for a little lost time, would thus require to be transmitted in about five seconds, and this was done with ease before the jury, when a short circuit only was used. These twenty words represent about 100 letters, and as many as nine reverse currents are frequently sent on one wire in the course of each letter; thus, the above speed requires 180 reversals per second, or 10,800 reversals per minute, through each wire.

It is very doubtful whether this enormous speed can at present be realised over lines of any length, where induction and leakage come into play. Even Professor Wheatstone's automatic transmitter, sending 600 letters per minute, does not require more than about 4,000 reversals, and it is still doubtful whether this speed can be attained in practice on lines of any length, even with the most sensitive electro-magnetic receiver. Moreover, to effect the electro-chemical reaction, powerful and well-separated currents are required. The system is, however, shortly to be tested practically, and certainly exhibits many points of interest. Even if successful, M. Bonelli's claim must rest on the fact that his messages are printed in common legible characters, instead of in symbols; for the other automatic systems exhibited would considerably exceed him in speed. Thus, Messrs. Siemens with ten wires would transmit 800 words per minute, and Professor Wheatstone 1,200; whereas M. Bonelli can only promise 166, or, not allowing for stoppages, say 240.

10. *Special Application of the Electric Telegraph to Railway Signals.*

Few applications of the electric telegraph are more important than its use in connection with railway traffic. In many parts of Germany, and on some lines in England, no train is allowed to pass any station until the departure of the preceding train has been telegraphed from the station in advance. This plan was first proposed by Mr. Cooke, and is known as the "block system." When this system can be strictly adhered to, collisions are clearly impossible, but its general adoption would necessitate the establishment of several telegraphic stations between each passenger station, as it would otherwise restrict the traffic on most English lines within very inconvenient limits; whatever code of rules and signals be adopted, it is clear that the management of a line is greatly facilitated, and its capabilities for traffic greatly increased, by the electric telegraph.

The common needle instrument is much used for railway purposes, and from its simplicity has some advantages. A signal received by it may, however, escape attention, or may even be misunderstood, and the message leaves no record. This defect has been remedied by the use of a permanent current maintaining the needle deflected to one side when the line is clear, and to the other side when it is blocked. Electro-magnetic bells have been introduced by Mr. Walker, instead of the needle instrument, as the sound can hardly escape attention. Mr. Walker's or other electric bells are also now generally used in connection with the needle instruments to draw attention to the deflections. Mr. Tyer with one wire only, and momentary currents, works a system of bell signals combined with a permanent visible record of the last signal sent and received.

The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2,978) exhibit a simple form of Professor Wheatstone's step-by-step magneto-electric dial instrument, adapted for railway signals. The twenty-six letters of the alphabet are in this instrument replaced by six signals on the dial, but the number of teeth on the propelment, and the number of currents sent during one revolution of the sending arm, remain as before; by this arrangement the loss of one or two steps is rendered of no consequence, since the index will even then be brought so near the signal required, as to show clearly which is meant. The continuous motion of the armature in front of the coils is therefore unnecessary, and the armature of this instrument is stopped and started by hand in the old manner. An alarum is sounded at each signal, and the signal received and sent remains permanently visible. It is obvious that, instead of six different signals, a larger or smaller number could be used at will.

C. V. Walker, H. M. (United Kingdom, 2,983), exhibits the bell railway signals first introduced by him on the South-Eastern Railway in December, 1851. There are now 321 of these instruments at work. The hammer of the bell is attached to the armature of an electro-magnet, the coils of which are of very large dimensions, and formed of thick wire. The signals are sent by a common contact key, and one blow is struck on the bell for every contact made. An arbitrary code is used in which the signals depend on the number of blows.

Mr. Walker occasionally so arranges the bells that a guard of a train delayed between two stations can signal to the stations on either side of him without any battery. This is effected by maintaining equal but opposite (and therefore balanced) currents constantly on the line from the two stations; when either station connects the line with the earth the other station receives a signal, and when the line wire is connected with the earth at any intermediate point both stations receive a signal. The means of making this temporary connection are provided at certain telegraph posts at short distances. One of the instruments exhibited has an index attached, worked by a simple propelment, to show on a dial the number of currents received. The bells are worked direct, or without a relay, over distances of about ten miles, with thirty of Mr. Walker's graphite plates.

Together with these bells, Mr. Walker shows two contrivances for registering the signals sent and received: one, called the globotype, registers by different coloured balls dropped into a long inclined channel from different tubes by valves or traps worked by different electro-magnets. One colour denotes signals sent, a second signals received, and balls of a third colour are dropped at fixed intervals determined by a clock. Thus, the succession of the signals,

and the time at which they were sent or received, can be verified at any time during the day. The same object is effected by the linoscribe, the second contrivance alluded to, which depresses a thread of cotton into one or another coloured ink, when one or another armature of various electro-magnets is moved; the thread is at the same time pulled forward a little way. These two latter instruments have been used, but Mr. Walker does not recommend their adoption owing to their complexity.

(To be continued.)

MODERN WONDERS IN TYPO-TELEGRAPHY.

It will not be necessary in this journal to say much about the general principles of electro-telegraphy; most of our readers know that the moving power is sometimes galvanism, sometimes magneto-electricity; that sometimes one wire, sometimes several, transmit the impulse; that this impulse travels an immense distance in an almost inappreciably short space of time; and that the wires may pass through air, earth, or water, provided proper insulating means be adopted. But one matter which is not so well understood is this—What kinds of signals are used; or, more exactly, how are the messages put into form at one end of the line, and recorded at the other?

Up to the present time arbitrary signals are employed more extensively than alphabetical letters to express the message. Some systems do not use any alphabet at all, properly so called; for the operator, by moving a handle to and fro in various directions, makes a needle simply *point* to the letters of the alphabet as they are wanted; and the impulse transmitted along the wire causes the needle of the receiving apparatus to point to similar letters. Most inventors are, however, now directing their attention to such forms of apparatus as will enable the telegraph actually to *write* or *print* its message on paper, either in the ordinary alphabet, or in some arbitrary characters. Professor Morse's system consists of a series of dashes and dots, the lengths, positions, and distances of which are made to denote different letters or signals. No matter whether the letter A is represented by a dash, or a dash and a dot; if the particular symbol is agreed upon, either will suffice. The recording instrument at one end marks on paper a series of dashes and dots; the receiving instrument at the other end marks almost simultaneously a similar series of dashes and dots; and a printed code for the service of the clerks enables the receivers to read the meaning of the senders. Professor Steinkeil's system dispenses with dashes, and forms all the symbols for letters by variously distributed dots, marked on chemically-prepared bands of paper. In both of these systems care is taken that the letters most frequently used shall be expressed by the shortest groups of symbols. Mr. Whitehouse, Mr. Allan, and Professor William Thomson have all devised ingenious forms of this dot system, applicable to various developments of the telegraphic apparatus. In order to produce the dashes and dots here adverted to, various hand-worked contrivances are employed. Morse's dash-and-dot signals are usually transmitted by a simple rocking lever, worked up and down by hand between two stops. The British and Irish Magnetic Telegraph Company, and some other telegraphers, employ an apparatus in which the finger presses down a key, connected with a lever by which the dash-and-dot writing is effected when the electric current is in proper action. Numerous other little contrivances are adopted by various inventors and companies, in which the hand or finger is employed to make successive movements on levers or keys, to produce the various systems of dashes and dots through the medium of the electric current. Then, at the other end of the copper wires—say a hundred miles away—is a receiving apparatus, to which the dashes and dots tell some sort of tale or other, comprehensible to the receiving clerk. The modes of doing this are very diverse. The *needle* instrument, hitherto much employed, comprises certain small magnets which, put in action by the electric current, move an index needle; and the receiving clerk, observing these movements, determines from them the number and order of the dashes and dots, and interprets the message accordingly.

In Professor Morse's recording instrument a small magnetic apparatus, influenced by an electric current received from the other end of the wire, causes a metallic point to press momentarily on a strip of paper; the paper is drawn forward at uniform speed by clockwork, and the momentary and often-repeated pressures by the metallic points leave on the paper a series of slightly-embossed marks of various lengths, which the receiving clerk can read by means of his code of signals. In Messrs. Digney's apparatus, the embossed marks are superseded by ink marks, which are more legible and more permanent. A small circular disc is kept moistened on its edge with ink from a saturated felt roller; the disc is made to revolve, and the travelling strip of paper is made to touch it for minute portions of time; and thus the message is delivered at the receiving end in the form of inked dashes and dots. The embossed lines and dots are much used in the telegraphic systems of Germany and Switzerland; the ink lines and dots are coming largely into favour in France. Many new modes have been recently introduced for applying the ink to the edge of the disc. At the present time, a problem remains to be solved by the electro-telegraph companies, whether to adopt an *acoustic* or a *recording* receptive apparatus; the electric wire can ring a bell as well as mark permanent dashes and dots; signals conveyed by the former means are not permanent, but are cheap to manage, while those by the latter means are more expensive, but are permanent; it is probable that the exigencies of commerce will find suitable employment for both systems.

Wholly distinct from the above are the *dial*, or, as some call them, the *step-by-step* telegraphs. They are all modifications of the first dial telegraph introduced by Professor Wheatstone in 1840. The pervading principle of them all is, that letters are marked circularly on a dial, and that the operator spells out the letters of his message by moving round a handle until an index points to the particular letter wanted. The electric wire, put into activity by this means, causes a similar index to point to a similar letter on a similar dial at the receiving station, or records the signals by any one of several other means. Instead of a lever, most of the dials have finger-stops, each one to be touched according to the letter near which it is placed. The disadvantages of most of these dial telegraphs are said to be, that the correct transmission of each letter depends on the correct reception of the foregoing letter; insomuch that one error in the reception throws all the subsequent letters wrong; and that the number of currents required for each signal is so large as greatly to increase the chance of failure. On the other hand, any person who can read or write can send and receive signals by these means; and, as no battery is wanted, the instrument is always ready.

We have now an important advance to notice. In the various systems hitherto described, the signals, whatever they may be, are produced by hand, each requiring a separate act of volition and a separate movement of the hand. But there have been devised modes of so employing *automatic* mechanism as greatly to increase the rapidity of transmission—or rather, to increase the number of messages that a single wire could convey within a given time. In all these new methods, the message is in some way mechanically represented, say by punched paper or by arranged type. Several clerks may be engaged in another room, without any necessary knowledge of electric telegraphy, in punching the paper or arranging the type; and then, when the messages are once prepared, they can be transmitted with wonderful rapidity along the wire. Professor Wheatstone's Universal Private Telegraph acts upon this plan. A strip of paper is made to pass slowly along a groove; the finger, pressing on certain keys, causes three punches to punch holes in the paper; and those holes, by their sizes and grouping, are made to represent letters and words. When a strip thus prepared is drawn through the electric machine, it causes an apparatus at the other end of the line to write down the message in similar characters. The time consumed is in *preparing* the message; the *transmission* is almost instantaneous. The most expert clerk cannot signal more than about 120 letters per minute by the hand method, whereas 600 can be transmitted when the letters are punched beforehand. Mr. Allan has a similar mode of using punched paper; but the depression of a single key punches all the group of dot-holes for one letter. Messrs. Digney punch the strips of paper with long or short rectangular holes, to produce their code of dashes and dots. Messrs. Siemens & Halske, instead of punched paper, use moveable types of metal, each type presenting an alternation of ridges and hollows not like the ordinary letters of the alphabet, but such as will produce dashes and dots.

In connection with Wheatstone's *automatic* (as distinguished from the *voluntary*) system, a suggestion has been thrown out of so remarkable a kind, that we are induced to give it in the words of the original. It occurs in the Report of the Jury on Electrical Instruments at the International Exhibition in 1862:—"If the public could be induced to learn a telegraphic alphabet, and to *prepare their own messages*, the success of the automatic system

might be expected with much confidence. Thus a merchant's clerk might prepare the messages of the firm in the punched paper required for Professor Wheatstone's transmitter. This prepared paper, on delivery at the telegraph office, would simply have to be passed through the machine when its turn arrived; and the corresponding dotted tape at the distant station could at once be addressed and delivered, to be deciphered by the receiver at his leisure. The functions of a telegraph company would then be nearly similar to those of the present post-office. The messages of prepared paper received would have to be sorted and transmitted in batches to the several towns by being passed through a machine at one end of a wire, at the other end of which the counterpart would appear. These counterparts would then have to be again sorted, addressed, and sent out as letters are now. Every yard of paper sent through the machine might be charged at a certain rate, without any reference to the code, language, or number of words. No great skill would be required to prepare or decipher the message, since these operations could be done leisurely; the functions of the company would be reduced to those strictly essential, and their responsibilities much diminished. Although seeming somewhat visionary at present, it is just possible that some such plan may some day be adopted, and that telegraphic dispatches may then be sent as cheaply as letters are now."

There is now being brought under public notice a system invented by M. Bonelli of Turin, the contriver of the very singular and beautiful electric loom for weaving; it is an improvement on an apparatus displayed by him at the International Exhibition in 1862. Unlike the other systems hitherto noticed in this article, Bonelli's telegraph *prints the message in Roman type*, such as is familiar with every school-boy. There are no arbitrary dashes and dots here. The types are Roman capitals, about one-eighth of an inch high—or rather, they are midway in character between Roman and Egyptian capitals. They are cast in ordinary type-metal, and can be arranged in a long line of words after very little practice. Suppose a Manchester manufacturer wishes to ask a Liverpool shipowner, "At what hour this evening will your vessel sail for New York?" The types to form these words are "set up," as a compositor would term it, from a fount or large collection ready at hand, proper blank spaces being inserted between the words. They are arranged all in a row, and are fixed upon the face of a narrow sliding bar. The bar is carried to a small electric apparatus, through which it is passed slowly. The surface of every type, as it passes, is touched by a comb of five metal teeth, connected with five copper wires. Each tooth, when it comes in contact with the projecting portions of the type, sends a current through its line of wire; whereas no current passes when the tooth passes over the hollow portions of the type. At the other end of the line (say at Liverpool) is an apparatus with a row of five metal points. A strip of paper, steeped in some chemical solution, is made to pass under these points; and according as electric currents are or are not passing through any or all of the wires at any given instant, so do the five points make five lines of little interrupted dashes on the paper, so ingeniously contrived as to length and mutual distance as to produce very good imitations of Roman or Egyptian capital letters, similar, in fact, to the type employed at the other end. The metal points decompose the chemical solution with which the strip of paper is wetted, and produce a kind of brown stain sufficiently legible for all practical purposes, and also durable or permanent. The row of five points is producing this writing or printing on prepared paper almost at the very identical instant when the comb of five teeth at the remote telegraphic station is passing over the surface of metal types. Were it not that we have almost ceased to wonder at anything which electricity can achieve, we might well marvel that, in this system of typo-telegraphy, the *type* are at one end of the line, and the *printing* at the other. A printer, fed with electricity, instead of with beef and mutton, prints on a slip of paper which is or may be hundreds of miles distant; for the system has been successfully tried, not only between Liverpool and Manchester, but between Paris and Boulogne. A sort of long low carriage, travelling along a miniature railway on a table, receives two sliding bars in two grooves, and passes under and in contact with two combs of five metal points each; one sliding bar contains a line or row of arranged type; the other has laid upon it a strip of moistened prepared paper; and if two operators at two distant stations have properly signalled each other, one motion of the carriage will transmit a message in one direction, and *receive* a different message in the opposite direction. Nothing is more curious than to see this double process going on under our eyes. The assertions made by joint-stock companies are often of the *couleur-de-rose* kind, and therefore we cannot positively affirm that "the average time occupied in setting into type a message of thirty words is a minute and three quarters;" that "the time of transmitting such a message is six seconds;" that "five compositors at either station can compose from three to four hundred messages per hour;" and that "eight such compositors, in less than an hour and a half, could have set up the whole of Mr. Bright's celebrated Rochdale speech, consisting of forty-nine thousand letters." But though we cannot vouch for this, we can answer for the beautiful and ingenious way in which scientific principles are here combined to produce a certain desired result.—*Chambers's Journal.*

MR COOKE'S PAMPHLET OR SKETCH OF 1836.

The early history of the Electric Telegraph has hitherto been but imperfectly told. Numerous works have been published from time to time; the authors, however, appear to have had but a limited acquaintance with the toils and anxieties of those to whom we are indebted for the adaptation of electricity to a practical system of telegraphing. There were not the facilities at that time which we now possess to make known the progress of discovery. The scientific works were expensive and few in number, and the daily press, with one or two honourable exceptions, rendered no assistance in preparing the public mind to receive the electric telegraph as a project capable of practical application. The inventors, Messrs. Cooke and Wheatstone, however, toiled incessantly, overcoming all difficulties, until at last the "wonders of the wire" could no longer be ignored. We publish this week the first portion of a pamphlet written by Mr. William Fothergill Cooke in the year 1836, in which he pointed out the advantages to be derived from the application of electricity for telegraphic purposes. Our readers will be able to judge how far the suggestions which it contains are carried out. It contains many valuable hints which might be beneficially adopted, even at the present advanced state of the telegraphic science.

We have often heard the question asked, how is it that two gentlemen, who have by their joint labours conferred on the civilized world such vast advantages, are allowed to remain without some special mark of approbation?

Plans for establishing on the most extensive scale, and at trifling expense, a rapid telegraphic communication for political, commercial, and private purposes, especially in connection with the extended lines of railroads now in progress, between the principal cities of the Kingdom, through the means of electro-magnetism, by William Fothergill Cooke.

The Inventor of the instrument and system which are the subjects of the following pages has availed himself of an idea suggested many years ago by a Mr. ——, of ——, and since renewed by Professor Weber, of Göttingen, under a varied form. Mr. —— proposed to convey along isolated wires, a series of electric shocks, which, according to their number, would have reference to a signal key of letters or sentences, &c. Professor Weber, in 1832, struck by the amazing rapidity with which a suspended magnetic needle obeyed the impulse of a galvanic current conveyed along a great length of wire, proposed employing it for telegraphic purposes, the easterly and westerly deviations caused by reversing the direction of the current offering an alternation of two symbols. The apparatus hereafter mentioned is worked on a different principle altogether, the galvanic agency being, however, still employed.

The national importance of some practicable method by which the benefits of a rapid telegraphic communication may be extended, at a cheap rate, to political and mercantile affairs, and, in all cases of emergency, to the private concerns of individuals, is too obvious, either to require argument, or admit of question; and it seems only to be needful that a clear statement should be given of the manner in which this object may be attained, to ensure general encouragement and support for the execution.

Improvement, however, which in every other department involving the convenience and exigencies of society, has, especially of late years, made the most rapid and unexampled progress, we find inactive here.

The enormous expense attending the present system of telegraphing, whilst is offers an insuperable obstacle to the establishment of a line of telegraphs for any objects but such as are of the most essential importance, is felt even by Government as a sensible weight in the short line between London and Portsmouth, the solitary instance in which it has been called into action, even in affairs of state.

This expensive system labours also under the following very serious deficiencies and imperfections, which, necessarily arising from the principles on which it is framed, admit of no remedy:—

I. The present telegraph is only available during day-light, *i.e.*, during less than one-half of each day upon the yearly average.

II. Even during day, it is dependent upon the weather, being interfered with in its action by partial rain, storms, morning and evening mists, and those dense fogs to which our climate is peculiarly liable during the short days of winter, when, for weeks together, its use may be suspended entirely.

III. The utmost vigilance is constantly required at each station; yet, along extended lines, communications are forwarded with slowness and uncertainty, in consequence of which a degree of brevity, often objectionable, must be observed in the despatches.

IV. The symbols are publicly displayed, and their meaning thereby rendered liable to detection; a circumstance which has, on many occasions, led to the publication of the secrets of government.

The system here advanced causing expense so small as to bear no comparison with that now incurred, and effectually supplying the deficiences, and avoiding the imperfections above mentioned, offers advantages to the public, as well as to the Government, which it is hoped are not unworthy of consideration. The Electro-Magnetic Telegraph which the writer has invented for this purpose is small, compact, and portable, yet very strong in its construction; is unaffected in its action by darkness, or any obstacles of the atmosphere; the first signal being an alarum, which continues its call at intervals till answered, demands no vigilance; its action at any number of connected towns, stretching from one end of the kingdom to the other, may be considered as simultaneous, since the electric fluid traverses many hundred miles in a time too short to be appreciated; it ensures correctness in the notices given, being so arranged that each signal to be represented to others, is at the same instant, presented to the eye of the signaliser; it precludes the possibility of any but confidential clerks seeing the symbols given, and to which, when requisite, they would have no key. Lastly, as an advantage peculiar to itself, this instrument, by the instantaneous transmission of notices, sets the most broken dialogue on the some footing with a single despatch. Though not impracticable before, it may perhaps be said that, by this system, Telegraphic Dialogue is introduced.

For the execution of this plan, the only requisites are, that one of these instruments be kept at each of any number of towns, between which intercourse is to be carried on, and that two copper wires, properly defended, be laid in the earth, along the intervening line of road, by which the instruments may be connected with each other, and the telegraphic notices conveyed. Admitting the capability of the instrument, and the correctness of the principle, yet two apparent difficulties in the execution of the project will naturally suggest themselves to the reader, viz.:—

1stly. The liablity of small copper wires, extending for some hundreds of miles to receive injury; and, 2ndly, the difficulty of determining the place where such injury has been received.

Since any serious inconvenience here would, indeed, form a weighty objection against the system, it may be as well to consider how these difficulties may be effectually obviated, before proceeding further. Injury to the wires may result either from, I., a gradual decomposition of the metal; II., a fracture, owing to the partial settling of the ground; or, III., external violence—either accidental or designed.

I. Copper, as is proved by the perfect state of ancient coins, which have lain buried for ages, is subject to very slow decay, and the protecting trough, already described, by guarding the wires from moisture and air, would effectually preserve them.

II. Along old-established roads, and below railroads now forming, no settling of the old soil would occur, but, to avoid ill effects, where the soil is not consolidated, and to admit of contraction from change of temperature, the wires would be laid with a sufficient degree of laxity to allow of moderate elongation, without exerting tension on the metal, which, from its softness and toughness, is nevertheless capable of supporting a very considerable strain.

III. From external violence of an accidental nature little apparently need be feared, and it may be difficult to suppose any so great, as to form a probable cause of injury to the wires at a depth of two feet below the surface of the ground. Against such as is designed, the ordinary precautions can alone be resorted to. It may be observed of both these cases, that the road would, on a careful inspection (conducted on a plan presently to be described,) offer such marks as would immediately point out where the injury had taken place.

(*To be continued.*)

CORRESPONDENCE.

TELEGRAPH COMPANIES.

To the Editor of the Telegraphic Journal.

Sir,—A spirit of speculation has evidently overwhelmed the hitherto sedate telegraphic world. New companies are started in all directions. I have heard of eight already endeavouring to leap into existence, in addition to those already brought out within the last month. Let us pause. Telegraph property has not yet been the most remunerative. We have already one or two companies of some years' standing which have yielded no dividend; and as the ground is tolerably well occupied, the prospects of new undertakings must be a precarious one. Let the existing companies reduce their tariffs, not only in the United Kingdom, but for continental messages, then we may hope for a speedy increase in their receipts. The introduction of the shilling scale has greatly increased the use of the telegraph among the people generally, and I have no doubt but that a further reduction would lead to the most beneficial results, and would ultimately prove exceedingly profitable. With a population of 32,000,000, one message for each person in the year would yield an income, at sixpence each, of some £800,000. The enormous increase in the number of letters which followed the reduction in the postal charges of the country, points out the probability of a similar increase in the number of telegraphic messages were a low uniform charge adopted.—Yours, &c., J. L. Davis.

April 13, 1864.

To the Editor of the Telegraphic Journal.

Sir,—Much has been said in praise of Sig. Bonelli's typo-electric telegraph, especially as regards the great speed attainable; so much so, that the writers of our professional periodicals, poetically inspired, point towards the possibility of its becoming a formidable rival to the schemes of Sir Rowland Hill.

But, considering the line requires from five to nine wires, the writer of these lines can only see a retrograde movement in the adoption of such a system.

Our present electricians and telegraph engineers aim chiefly at producing a cheap well-insulated single wire line served by effective instruments; and such genii as Frischen and Siemens even have schemed out arrangements for sending messages at the same time from both ends of one wire. By working in that direction alone a saving, and, consequently, large reduction of charges may be arrived at, and not by ninefold increasing the cost of line; and, after all, only doing the work others can do with two wires, disregarding entirely the great many interruptions a line thus complicated necessarily must be exposed to; for, be it remembered, the chances against it are not merely as the number of wires, but as their combinations to one. I am here alluding to Siemens, Halske, & Co.'s typo-printing telegraph, exhibited in 1862, by which eighty words per minute were transmitted through a circuit of two thousand miles, including fifty miles submarine cable between England and France, from the Submarine Telegraph Company's offices, dispatched by gentlemen neither of whom had any practice with the instrument, or had previously seen it.

This instrument only requires one line wire and no battery. Should any company have sufficient traffic to keep it spinning night and day, they might well reduce their charges to one-tenth of the present, but not the promoters of Bonelli's: so much for the consolation of other companies.

I shall be most happy in furnishing you with a detailed description of the above instrument for one of your next numbers, so that your readers may judge for themselves how far I am right in pointing to it in preference, not alone of Bonelli's, but all other existing Roman-type printing telegraphs of the day.—I am, dear sir, yours very truly, G. R.

TELEGRAPHIC NEWS.

New Zealand.—An electric time-ball has been erected upon the roof of the custom-house at Wellington.

Telegraphy in Mexico.—The French Government are dispatching a large staff of experienced officers and engineers to Mexico, to construct extensive lines of telegraph, for which the materials are also being shipped.

Atlantic Telegraph Company.—We are given to understand that the contract of Messrs. Glass, Elliot, & Co., is not only to manufacture and submerge the Atlantic cable, but to keep the same in working order for twelve months. If we are correctly informed, this latter feature of the tender bespeaks the confidence of the contractors, and is calculated to give assurance to shareholders in the undertaking.

The Persian Gulf Telegraph.—Information has reached the India-office, Victoria-street, that the whole of the above cable has been successfully laid, and that it was in excellent working order. The message, we believe, was transmitted from Bushire via Constantinople. Sir Charles Bright has taken his departure for England, and is expected to arrive in about a week's time.

The Telegraph between Europe and America.—We understand that Her Majesty's Government have granted the concession of a right of way through British Columbia, for an electric telegraph to connect the existing United States lines with those to be extended from Russia, across Behring's Straits, a concession for the latter portion of this line having previously been given by the Russian Government to Mr. Collins, an American citizen.

Ionian Islands.—A letter from Corfu, dated 10th ultimo, says:—"A great explosion took place last evening at Fort Abraham, fifty shafts having been set off at one time by electricity. The destruction was immense; and I thank God no accident occurred. All here is hurry and bustle to be ready by the end of April, when it is expected that the King of Greece will take possession of the place. The vessels of war are busily engaged in the roadstead shipping stores, &c."

Windermere Ferry.—A great boon has been conferred on that portion of the public who for business or pleasure are in the habit of crossing this ferry. On Tuesday, the 5th instant, an electric cable, covered with copper sheathing, manufactured by Messrs. Siemens, Halske, & Co., was successfully laid across the lake, from the Nab to the Ferry House, a distance of 600 yards, communicating with a patent railway alarm-bell, made by the above firm (the clockwork of which is released by the action of a current on the electro-magnet, generated from permanent magnets), the sound of which may be heard many miles, so, in future, parties desirous of crossing from the Nab have only to press down a light lever, and the whole retinue belonging to the Ferry Hotel will instantly be informed that the boat is wanted. This will, no doubt, be the means of doing away with the delays which have been so long experienced by those in the habit of crossing, and which have in many cases been attributed to the negligence of the proprietor of the ferry, or his servants; the whole of the work was undertaken and satisfactorily completed by Louis J. Crossley, Esq., of Halifax, whose gratuitous and valuable services cannot be too highly appreciated.

Submarine Telegraphy.—The Earl of Caithness, one of the directors of the Electric and International Telegraph Company, has just made a cruise, in the company's steamer Monarch, off the east coast, from which cables have been laid to the continent. Captain Blacklock, the company's submarine engineer, went out earlier in the month, for the purpose of repairing the cable from Lowestoft to Amsterdam, and the repairs were effected in three days, although the weather was rather rough. The fault was found in thirty to thirty-five fathoms, and at a distance of about thirty-five miles from the shore. Mr. C. F. Varley, the company's electrician, assisted in the superintendence of the repairs. When the Monarch put to sea, with the Earl of Caithness on board, she picked up some buoys which had been left out, and also took up a portion of the original cable, laid by the Electric and International Company, to the Hague, in 1853. Although this cable had been submerged eleven years, the parts recovered were found in excellent condition. The line just repaired has been described as the Lowestoft and Amsterdam cable, but, strictly speaking, it should be called the Lowestoft and Zandvoost line, as it touches the Dutch coast three or four miles from the Hague. The company has also another cable, from Dermvich to Zandvoost. Each of these cables contain four wires, but the business developed with the continent has become so considerable that it is not improbable that a third line will be laid.

Continental Telegraph Line through British Columbia.—I find in one of our English journals the announcement that T. McD. Collins had recently had an interview with the Duke of Newcastle, at the Colonial-office. This interview probably had reference to Mr. Collins' projected telegraph line from Russia through British Columbia. Much curiosity is still afloat in telegraph circles touching the nature of the contract which Brutus J. Clay recently claimed to have concluded with the Emperor of Russia. It is possible that there may be certain parties in those circles who are well posted in the matter, but who, for reasons of their own, choose for the present to keep what they know to themselves. The quietness with which Collins has been operating for the past twelve months has led some people to surmise that he has really put the Russian part of the business into the hands of Mr. Clay. Since the foregoing was written I hear that letters have been received in town from Mr. Collins. He states that the object of his interview with the Duke of Newcastle had not been definitely attained, but that matters, on the whole, looked very encouraging, and he felt no doubt of ultimate success. I also hear that Mr. Clay has had nothing whatever to do in St. Petersburg with Mr. Collins' enterprise, and that there is much doubt felt and expressed as to his having had any connection with any other project of a similar nature.—*Correspondent of the Weekly British Colonist.*

A Telegraph Clerk Committed for Manslaughter.—The district coroner, W. H. Brewer, Esq., on Thursday re-opened the inquest at the Hanbury Arms, Aberbeeg, on the bodies of John Williams and William Worthing, who were killed on the Western Valley branch of the Monmouthshire Railway, on the 17th ult. The evidence having been read over to each witness, the coroner summed up, and the jury, after the deliberation of nearly half an hour, returned a verdict that the deceased died from injury received at an accident on the 17th, which accident was caused through the negligence of the telegraph clerk, James Yendoll, of the Aberbeeg station, against whom they returned a verdict of manslaughter. The coroner read the report of the inspector of the Board of Trade, who thoroughly condemned the condition of the line, and recommended that the staff system should be adopted.

Dean Clough Institute, Halifax.—On Wednesday, the 6th instant, the members and friends of this institute held their first *soirée*, in the Odd Fellows' Hall, when upwards of 500 persons sat down to an excellent tea. The spacious room had been tastefully decorated for the occasion with mosaics, banners, festoons, and fabrics of various hues, and mottoes, the whole having been carried out under the superintendence of Mr. Harry Crossley and Mr. Lochead. After tea the chair was taken by Mr. John Crossley, and a most interesting public meeting was held, no pains, trouble, or expense having been spared in catering for the amusement of the assembled guests. During the evening some excellent pieces of music were performed by a string band, and there were also present several members of the Halifax Glee and Madrigal Society, assisted by Miss Illingworth and Miss Nalton, of Bradford, and Miss Suter, of Halifax, all of whom sang remarkably well, and were much applauded. The pieces selected were as follows :—"Tramp, now tramp," "Barney O'Hea" (Miss Illingworth), "Come if you dare," "Health to my dear," "Away to the mountains' brow" (Miss Suter), "When shall we meet" (Miss Illingworth and Miss Nalton), "Market chorus," "The ship boy's letter" (Miss Nalton), and "The fisherman's good night." Mr. Stringer presided at the pianoforte. At intervals brief addresses were delivered by the chairman, the Rev. W. Roberts, the Rev. R. Harley, F.R.S., Rev. C. Clark, Rev. W. Hewgill, M.A., and Mr. F. H. Bowman, F.C.S. Mr. Roberts, in his speech, spoke of the importance of combining recreation and labour, and said he believed that play was an essential part of their life, both bodily and mental. He knew nothing more natural, more proper, and more pleasant than that they should have those entertainments, to lighten life, and to make it more comfortable. He spoke of the efforts which Mr. L. J. Crossley and Mr. E. Crossley had put forth to render the entertainment on that evening a great success, and said he did not know that they could have done anything more noble, or anything that would pay them better in personal comfort, and in the estimation of their workpeople which would be accorded to them, than of having got up such an entertainment as that. The remainder of the evening was devoted to telegraphic experiments, wires having been fixed in all parts of the room; and these were quite an attractive feature, and were well received. The working of the electric telegraph was superintended by Mr. L. J. Crossley, and between the hall and Manchester Hughes' Roman Type Printing Telegraph was used, which the United Kingdom Telegraph Company have the sole privilege of working on their lines. Then there was Sir Charles Bright's bell instrument, between the hall and Leeds; and Messrs. Siemens, Halske, & Co.'s ink writing instrument between the hall and Leeds, London, Bradford, Hull, and Manchester; also, Messrs. Cooke & Wheatstone's single needle instrument between the hall and Sheffield direct. Then there was Messrs. Siemens, Halske, & Co.'s dial instrument, and Messrs. Cooke & Wheatstone's double needle instrument from one end of the room to the other. During the evening several messages were despatched by persons in the audience to the various towns already named, and answers were in every case promptly received. One of those questions was to Leeds, and was as follows :—"Which town do you think is entitled to be considered the metropolis of the West Riding?" the answer to which was, "Why, Halifax, I should say, of course"—(laughter). During the evening Messrs. E. Crossley, J. W. Ward, and F. H. Bowman exhibited some microscopes and stereoscopes, and some galvanic batteries were also brought into full play. At the close of the proceedings Mr. Lochead moved a vote of thanks to their young employers for their kindness in getting up the entertainment, which was seconded by the Rev. J. Bottomley, of Sowerby, and carried with acclamation. Mr. L. J. Crossley, in acknowledging the compliment, expressed the obligations the meeting was under to the telegraphic clerks in London, Manchester, Leeds, and other places; and Mr. E. Crossley also addressed a few observations. The Rev. W. Roberts moved a vote of thanks to the singers, which was seconded by Mr. Diggins, and carried amid loud applause. Mr. Hoyle moved a vote of thanks to the chairman, which was seconded by Mr. N. Thompson, and carried with enthusiastic cheering. The proceedings were brought to a termination by the singing of the National Anthem. The following is an abstract of the report of the institute for the year ending March 31st, 1864 :—In the news-room there were six daily and eleven weekly newspapers, and two quarterly and ten monthly periodicals. The library contains 2,526 volumes. The number of issues in the special department had been 325, and the number of magazines 690. There had been five public readings, and three lectures, and the average attendance had been 150. The present number of members was 480, whereas last year it was only 285.

MISCELLANEA.

It is curious to take a retrospective view of the mode in which the effects of the Leyden phial were announced to the world on their first discovery. The philosophers who first experienced in their own person the shock attendant on the transmission of an electric discharge were so impressed with wonder and with terror by this novel sensation that they wrote the most ridiculous and exaggerated accounts of their feelings on the occasion. Muschenbrook states that he received so dreadful a concussion in his arms, shoulders, and heart that he lost his breath, and it was two days before he could recover from its effects; he declared also that he should not be induced to take another shock for the whole kingdom of France. Mr. Allemand reports that the shock deprived him of breath for some minutes, and afterwards produced so acute a pain along his right arm that he was apprehensive it might be attended with serious consequences. Mr. Winckler informs us that it threw his whole body into convulsions and excited such a ferment in his blood as would have thrown him into a fever but for the timely employment of febrifuge remedies. He states that at another time it produced copious bleeding at the nose; the same effect was also produced upon his lady, who was almost rendered incapable of walking. The strange account naturally excited the attention and wonder of all classes of people, the learned and the vulgar were equally desirous of experiencing so singular a sensation, and great numbers of half-taught electricians wandered through every part of Europe to gratify this universal curiosity.

Faulkner's Electric Signals.—These signals are so constructed as to give the winding signal from the surface to the bottom, and return signal from the bottom to the surface of the shaft, and also for signalling on the levels or inclines by touching the part of the signal constructed, either a greater or lesser number of times, as may be arranged. This will be found to save much inconvenience to the men working in the pit. The signals will also be found useful for warning the men to commence or cease work, by so many rings of the signal, which will be heard all over the pit. It is also adopted for ventilating doors, to indicate whether they are open or shut. For instance, if a ventilating door which ought to be shut is, by neglect, left open, the signal is so constructed upon a self-acting principle that it will ring off any number of hands with a tremendous noise until the door be closed. By a singular arrangement, if a door which ought to be open is by any means closed, the signal will also ring until it is opened. If the door is only open one-sixteenth of an inch it will set the signal at work with as great a noise as if it were left wide open. In order to show from what part of a mine a signal proceeds a box or partition may be fixed in some conspicuous place, with a number-plate and a number for each part of the pit which it may be desirable to indicate. These number-plates are fixed by hinges, so as to move in or out, and the electric wire is fixed to each number-plate corresponding with that part of the mine which it represents. Thus, when a signal is rung, the number of the part from whence it comes is projected outwards. This invention, in fact, may be used for any purpose of warning, or calling, or signalling in the pit; and it is to be observed that when any signal is touched it can be distinctly heard all over the mine.

Meteorology.—The following interesting results of the ascent of Messrs. Glashier and Coxwell will be read with interest:—Mr. Coxwell had been watching the weather all day; and once during a break in the lower clouds he had sent up a pilot balloon, which had moved towards the east when at a high elevation, and, connecting this with the current we had met with, he began to fear that the railway we had heard might be the Southend Railway, and if so we were drifting out to sea. He, therefore, determined to take a dip downwards without delay, before attempting a higher elevation, so that if we found ourselves over the water we might have gas enough to keep us up for some time. We began to dip downwards. The sky continued of a deep blue, the air free from mist, and the sun hot till we approached the height of 7,000 feet, and at 6,000 feet we lost sight of the sun, and were in dense white cloud at 5,500 feet; when at 3,000 feet fine rain fell, and we caught sight of the earth at the height of 2,500 feet. We expected to find ourselves over Essex; but hills and a beautiful undulating country presented themselves, and it was evident we were at fault. Mr. Coxwell then decided upon anchoring, and we did so on the outskirts of a pine plantation, near Sevenoaks, in Kent, on the estate of the Marquis of Camden, and we found the direction of the wind here south-east, the same as that at starting. The temperature of the air was 46 deg. on leaving; at the height of 1,000 feet it was 41½ deg.; at 1,500 feet it was 40 deg.; at 2,000 feet 37 deg.; at 3,000 was 32 deg.; from 3,500 to 4,000 there was no variation from 32 deg.—this was the lowest temperature met with; at 5,000 feet the temperature increased to 36 deg., and did not change for 500 feet, then decreased to 34 deg. at 6,500, at which point it turned to increase, amd was 40 deg. at 8,000 feet; it decreased to 34 deg. again at the height of 9,000 feet; it then increased on leaving the cloud below to 36 deg. at 11,000 foot, and rapidly to 46 deg. whilst between 10,000 and 11,000 feet high. The highest temperature observed was at 8,000 feet in descending, when it was 47 deg.; from this point the temperature declined, on descending, to 40 deg. at 1,500 feet high, being nearly the same as on ascending, and to 46 deg. on the ground. The temperature of the dew point, or that temperature at which water in the invisible shape of vapour is deposited as water on substances of that temperature, was 7 deg. below that of the air on leaving the earth, and this difference was the same up to 2,000 feet; it then decreased to 1 deg. on entering the cloud, and was 1 deg. to 3 deg. whilst in the dense cloud; on leaving it at 8,000 feet this difference suddenly increased to 10 deg., and varied from 14 deg. to 24 deg. between the heights of 8,000 to 11,000 feet, and decreased on again entering the cloud to 5 deg. and 6 deg. There were 2¼ grains of water in a cubic foot of air near the ground, and about 2 grains in the cloud, and about one grain only above the cloud. The humidity of the air, therefore, increased from the earth to the centre of the cloud, where it was all but saturated, and decreased rapidly above the cloud where it was very dry. No ozone was detected by Schonbein, Moffat, or Lowe's test papers, during the time the balloon was in the air. The lines of the solar spectrum were very numerous and well-defined; the spectrum itself was very long.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine mixed, first and second qualities.....	2/3 to 2/6 per lb.
Good re-boiled..............................	1/7 to 1/10 „

India Rubber.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/5 „

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations,*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	97 to 100	—
100	Submarine Telegraph, scrip. .	all	48 to 53	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1 dis. to par	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

We shall endeavour to maintain strict impartiality in all matters relating to the great interest we seek to represent. Our columns are at all times open to fair criticism. The communications of "A Deluded Shareholder," "Dividend," and "Irving S. Taylor," are inadmissible, as containing unjustifiable insinuations against the public and private characters of individuals filling positions of the highest importance in connection with a great national undertaking. It appears to us somewhat presumptuous on the part of our correspondents to pass such sweeping condemnation upon the conduct of a great Company and its scientific advisers, who have pursued one steady and sensible course, by subjecting various improved materials and cables to experimental tests, and have selected those which they considered the best for the object in view.

Alpha.—The Directors of the United Kingdom Telegraph Company consider Hughes' system superior to Bonelli's.

E. W. M.—The invention to which you refer is Bakewell's.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)............	0	3	6

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THE TELEGRAPHIC JOURNAL.

Vol. I. No. 17.—April 23, 1864.

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ON THE APPLICATION OF ELECTRICITY TO DOMESTIC PURPOSES.

By William Henry Preece, Assoc. Inst. C.E.

(*Continued from page* 184.)

2. *The Wire.*—Having thus described the construction and action of the battery, we have next to consider the means employed to convey its influence to the bell. This is done by metal wires. There are some materials which readily allow the passage of electricity through them, while others offer a stout opposition to its course. The former class of bodies are termed *conductors*, the latter *insulators*. All the metals, charcoal, saline solutions, water, moist animal substances, the human frame, are conductors. Shellac, sulphur, resins, gutta-percha, caoutchouc, silk, glass, and most dry organic and vegetable bodies are insulators. There is, however, no absolute line of distinction between these two classes of bodies. There is no such thing as perfect insulation or perfect conduction. The two terms imply a difference of degree only. A bad insulator is a good conductor, and a bad conductor is a good insulator. There are many materials which occupy a neutral position which are difficult to define as belonging to either class. Every substance offers a certain resistance to the passage of the current. When this resistance is very small, as in the case of a metal wire, we have a conductor; when it is very great, as in the case of silk, gutta-percha, or india-rubber, we have an insulator. Hence, the conductor employed in dwellings is copper wire coated with an insulating substance such as india-rubber, gutta-percha, cotton steeped in some insulating solution, or even plain cotton alone. It is thus coated to maintain the current in its proper course, and prevent the various wires from becoming wet, or from coming into contact with each other. The wires conduct the current as water-pipes convey water or gas-pipes gas, and if we destroy the insulation by allowing them to touch each other, or to come into contact with wet, they would act the same as leaky pipes, and allow all the current to escape, and therefore prevent us from producing any sound upon the bell. The wires are employed in this way:—If we require to ring the bell, B (Fig. 5), it is necessary to take

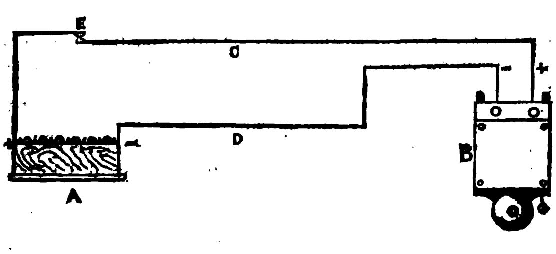


Fig. 5.

a wire, D, from one pole of the battery—say the negative pole—to one terminal of the bell, B;—the connecting thumbscrews of electrical instruments are called *terminals*. Another wire from the other pole is taken to E, the spot or room from whence the bell has to be rung, and from thence the wire, C, is carried to the other terminal of the bell.

It will thus be seen that when the two ends of the wire at E, which are maintained separate, are brought into contact, the "circuit" is completed, the battery is brought into play, the force is generated, the current flows, and the bell rings. The wire, C, is termed the *main wire*, and the wire, D, the *return wire*. It is not necessary that there should be a separate battery and a separate return wire to every bell: the same battery and return wire will answer for any number of bells; but this point will be subsequently more clearly illustrated.

The simplicity of this arrangement, and its advantage over the existing system, is that the wires can be led anywhere, under the paper, behind the skirting, or between the joists. They are never likely to be injured, unless they be broken by some repairs to the house. They should, however, never be fixed where wet is likely to reach them, unless they are well insulated with gutta-percha or india-rubber. Such an accident as a broken wire is at once shown by the bell attached to that particular wire ceasing to ring, and it is very easily rectified by twisting the broken ends together temporarily. A permanent joint should subsequently be carefully made, and always *soldered*. Soldering is essential in completing all joints of wires, even in private dwellings, in our damp climate; for if they be not done so, the natural moisture of the atmosphere is certain in time to produce oxidation upon the surface of the wire at the point of juncture, and thereby want of perfect electrical continuity in the wire. This would produce feebleness in the sound of the bell, and lead one to imagine that the battery was failing when it was really in full action. Failures and imperfections in telegraphy are frequently attributed to the battery or the instrument, when the true cause of trouble lies in improper or careless jointing. In damp positions and moist climates too much attention cannot be devoted to the perfection of joints.

It is not essential that the wires in the interior of a house be carefully insulated. The French use plain cotton-covered wire. But in England, where the climate is so much damper, some more insulation is advisable. It is sufficient if the cotton be steeped in a solution of caoutchouc or other insulating material. In out-of-door work, however, such as between the house and the stable or the lodge, high insulation is imperative. Gutta-percha-covered wires, properly prepared with tape or hemp saturated with Stockholm tar, will be found the best, and it is generally found advisable to protect them with pipes or some external protecting wire, and bury them at least eighteen inches deep under ground. Where practicable it is, however, preferable to use suspended wires; but as they are unsightly, they are generally objected to. Where sightliness is of no consideration, and where length can be obtained, it is easy to stretch a thin iron wire in one span of 400 or 500 yards. This is infinitely cheaper and far more durable than underground work.

3. *The Buttons.*—The apparatus employed to bring the two

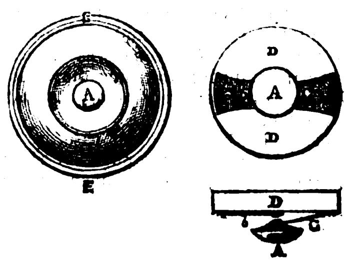


Fig. 6.

ends of the wire at E (Fig. 5) into contact is very simple. It is called *a button*.

D is a disc of wood, shown in plan and elevation to the right of the figure, upon which is fixed a small plate of brass, *b*, and to which is fixed a hardened brass or steel spring, *c*. The ends of the wires at E (Fig. 5) are soldered to *b* and *c*. An ivory button, A, which receives the pressure of the finger, is fixed to the end of the spring, *c*, which it presses into contact with the plate, *b*. The circuit is thus completed, the current flows, and the bell rings. In order to ensure perfect electrical contact between *c* and *b*, their ends are tipped with platinum or silver, which do not oxidize nor get dirty. The whole is protected by a box of wood or porcelain, E, having a hole in the centre to allow the ivory knob to be exposed, and which screws upon the wooden disc, D. It is shown complete to the left of the figure. The button is fixed to the wall or piece of furniture by driving two screws through the disc, D, before the top is screwed on.

The covering, E, should be occasionally unscrewed, and the points of contact scraped and cleaned. If they get dirty the current may fail to flow, and the bell fail to sound. The correct working of nearly every electrical instrument depends upon the care with which the points of contact are maintained clean. Strong currents of electricity invariably dirty to some extent the points of contact, even when they are silvered or platinized; but any harm resulting from this effect is greatly reduced by producing a rubbing contact by means of springs. When two pieces of metal are forced into immediate contact without any motion over their respective surfaces, they are said to be brought into *dead contact*, but when one metal moves to the smallest extent over the surface of the other it is said to have a *rubbing contact*. A rubbing contact removes any dust or dirt that may have accumulated on the points of connection. This is effected on the button by the spring, *c*, which rubs to a small but sufficient extent the plate, *b*. If not cleaned occasionally the dust may, however, accumulate so much as to master the effects of this rub.

The spring, *c*, may break from improper hardening, or the introduction of impure material. Springs, though most carefully selected, will sometimes fracture. This accident is, however, very remote, but its probability must not be overlooked. It can only be rectified by the insertion of a new spring or a fresh button. Spare buttons should be kept, to be prepared for such contingencies. In the last form of spring introduced by the French manufacturers this liability is reduced, by giving it a curved or spiral form, which increases the length of the spring, and thereby spreads the motion over a more extended surface.

It will be easily seen that these buttons can take any form to suit the particular locality in which they are placed. They may be made to act by a pull, instead of pressure, for a hall door. They may be constructed like a pair of nippers, to be placed under the pillow. They can be fixed under the tables to receive the pressure of the foot. Indeed, as they are required simply to bring two pieces of metal together, they can be made of any shape and for any purpose.

4. *The Bell.*—We have next to consider the bell—to comprehend the action of which it is necessary to explain briefly the magnetic properties of electricity. The influence of a magnet on iron or steel is too well known to need comment; but the action of an electro-magnet is not quite so well understood. If we take a piece of soft iron, and wind around it carefully and neatly a quantity of copper wire, covered with silk, to prevent one lap of wire from coming into contact with another, and then join the two ends of this wire one to either pole of a battery, so that the current may flow through the wire, and round the iron core, we shall find that the core has become a magnet, that it will attract iron and steel, that it is, in fact, an electro-magnet with all the powers of an ordinary magnet. This power, however, only exists during the time the current flows. The moment the current ceases all attractive power stops. Thus in Fig. 7, when a current is transmitted through

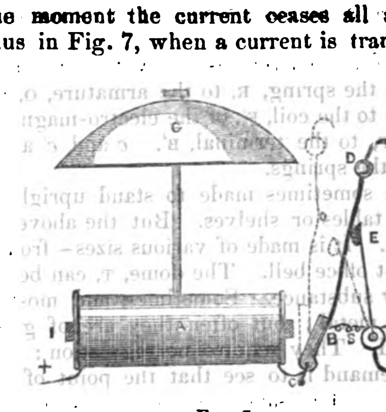


Fig. 7.

the electro-magnet, A, the iron core, I, becomes a magnet, the soft iron armature, B, is smartly attracted, the hammer, D, strikes the bell, C, and sound is produced. The moment the current ceases the hammer falls back by the action of the spring, S, and is prepared for another blow. Each current sent produces one blow on the bell. The above is a description of any direct-action electrical bell, but the French bells—"*trembling bells*," as they are significantly termed—are varied in this way:—The main wire which passes through the coil, A, is connected to the armature and hammer rod, B, which rests against a spring, E, in contact with the other end of the wire (—). Now, when a current flows, the armature, B, is attracted; the bell is struck, and therefore sounds; but the circuit being broken at E, the current ceases, and the hammer falls back again. The circuit is again completed at E, the current again flows, the armature is again attracted, and the bell is again struck, and again the circuit is broken, and the hammer falls back. These makings and breakings, attractions and fallings back, occur as long as the button is kept down, and the current flows. The result is a rapid trembling ringing of the bell, which is very effective and very singular. It ceases when the button is released and the current stopped.

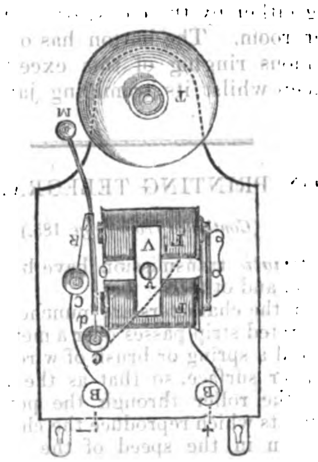


Fig. 8.

The above figure (Fig. 8) represents the ordinary French bell which is made to be attached to the wall by two screws or nails. Its action is precisely similar to that of Fig. 7. The current passes through the electro-magnet, FF′, the armature, O, is attracted, the bell is struck, the circuit is broken at R, the hammer falls back by the elasticity of the spring, *d*, contact is again made, the current again flows, the bell is again struck, and so on, rapid makings and breakings of the current take place, which produce the trembling movement of the bell.

The piece, V, keeps the electro-magnet in its position by means of the screw, v.

The course of the current is easily traced. It enters at B, passing through the spring, R, to the armature, O, to spring, d, and from thence to the coil, F′, of the electro-magnet, and out at the other coil, F, to the terminal, B′. c and c' are simply the studs that hold the springs.

The bells are sometimes made to stand upright, as Fig. 6, to be placed on tables or shelves. But the above is the most convenient form. It is made of various sizes—from a loud hall alarum to a light office bell. The dome, T, can be made of any note, and of any substance. Sometimes, and most frequently, they are of bell metal; but often they are of glass, and frequently of wood. They require no regulation; and the only attention they demand is to see that the point of contact, R, is maintained clean. The same remarks apply to this point, as I have previously given to the points of contact of the buttons.

These bells, as I have described them, ring only during the time the button is pressed down; but it requires the addition of a very simple piece of mechanism to make them ring continuously, from the instant a momentary pressure is exerted upon the button, until the attendant who is summoned by the bell stops it himself. With the above bell a little instrument is required, which, on the attraction of an armature, brings into play what is termed a "local" or independent circuit, which continues to ring the bell until it is mechanically broken; but there is a very ingenious bell by M. Ragon which accomplishes this of itself. The main current, passing through one coil of the electro-magnet, releases a detent that falls and completes a local circuit, which actuates the other coil of the electro-magnet, and by this means works the bell continuously, until, in fact, the detent is mechanically raised and restored to its original position by the attendant whose attention is required. Such a bell is an admirable alarum. It can be rung by a clock at any hour required, and will continue to ring until the drowsy sleeper is awakened. It is an admirable contrivance to fix in the servants' sleeping apartment, and rouse them up at the proper hour. Housekeepers will know its value. It can be set going either by the clock, or by the housekeeper in person, from her room. The button has only to be touched to start the continuous ringing of this excellent alarum. It is impossible to sleep whilst its trembling jar beats continuously on the ear.

ON PRINTING TELEGRAPHS.

(*Continued from Page* 185.)

Methods of *automatic* transmission have been invented by Bain, Allan, Wheatstone, and others.

In Bain's system the characters are punched out from a strip of paper. The perforated strip passes over a metallic roller connected to the line-wire, and a spring or brush of wires fixed to the battery presses on its upper surface, so that as the paper moves forward the wire touches the roller through the perforations, sending a succession of currents which reproduce the characters at the distant station. A variation in the speed of the two machines simply alters the lengths of the signs, without in any way confusing the message. This system was worked some ten years since between Liverpool and Manchester, at a speed of about seventy words per minute; but owing to the defective insulation of the wires at that period, and the difficulty of punching the paper by the imperfect apparatus employed, it was discontinued.

Professor Wheatstone has now perfected an automatic telegraph, founded upon the same principle, which bids fair to be very successful, and admits of a vastly increased speed. In Professor Wheatstone's system the dashes of the Morse alphabet are represented by dots placed on the right hand of the paper ribbon, and the dots by similar marks on its left. Another line in the centre of the ribbon serves to form the spaces between the letters and words. This arrangement permits the perforating apparatus to be very much simplified, and to be manipulated with comparative ease. The apparatus by means of which the punched slip transmits the message is on the principle of the Jacquard loom. In it three wires are placed in a position precisely similar to that of the punches in the perforating apparatus. They lie on the edge of an eccentric wheel, which at each revolution presses them against the paper ribbon. If a hole be opposite the punch, it passes through it, touching the metal wheel and putting the battery in action. One wire sends positive, the other negative currents, which act upon separate electro-magnets in the receiving instrument, so as to reproduce the signs in ink.

It is obvious that a similar effect can be obtained by etching the Morse characters upon a plate of metal covered with varnish, or by writing them in insulating ink upon a piece of metallic foil or silvered paper; and by chemical decomposition, Roman letters, or even a sufficiently bold handwriting, may be copied from the foil upon a sheet of prepared paper, by ruling a series of lines across the two with metallic pencils, connected with each other and with a battery.

When the sending pencil is drawn across that part of the foil on which nothing is written, and which therefore conducts uniformly, the receiving pencil will produce a straight line upon the moistened paper; but when the sending pencil moves across the *writing*, the current will be cut off by the insulating ink, producing corresponding breaks in the line formed by the other pencil; if the two pencils are so connected as to be capable of being moved uniformly over their respective sheets, and if a series of parallel lines be drawn closely together by them, they will form a copy of the original in a species of line engraving or etching.

Many years since Mr. Bakewell invented a copying apparatus founded upon this principle, by which fac-similes of hand-writing were transmitted from London to Brighton as early as 1848.

The so-called Pantelegraph of the Abbé Caselli is really worthy the name it bears, for it transmits Chinese or Persian characters as readily as our ordinary letters, and reproduces a correspondent's autograph, or even his *portrait* if required. The despatch is written in ordinary ink upon silvered paper, and by a peculiar arrangement of batteries the copy is produced in blue upon a white ground.

The practical difficulties of the system, simple as it may have seemed from the foregoing description, are very great. It is of course necessary that the markers at the two stations shall move with perfect uniformity, as if connected firmly together. The slightest difference in the speed of the two would be fatal. The colour is apt to run on the damp paper, and as the current on a long wire does not cease at the moment at which battery contact is broken, the marks as received are apt to be rather longer than those of the original, so as to merge one into the other.

The apparatus at all the stations is precisely similar. A massive iron frame carries a pendulum about six feet long, having a very heavy iron bob, whose movements are controlled by electro-magnets, which attract it at each oscillation and hold it fast until the current which magnetizes them is cut off by a regulator clock, the going of which can be controlled with the greatest nicety without stopping it. The large pendulum, whose beats exactly correspond with those of the regulator, gives motion to two curved tables, one on each side, on which the prepared paper or original despatch is laid. The metal tracers or pencils are fixed above these tables in such a manner that they pass over the paper as it moves, ruling a line at each vibration of the pendulum. The pencils are connected with screws, which move them the ninetieth of an inch between each vibration, so as to rule a series of lines a ninetieth of an inch apart. They cannot be arranged so as to pass over the paper in both directions without tearing it, and are therefore lifted alternately. To avoid loss of time from this arrangement two despatches are transmitted at the same time, one while the pendulum swings to the right, the other while it moves to the left. The clocks at the two stations are kept in perfect accord by altering their rate during the progress of the transmission, in such a manner that a straight line which is ruled at the edge of the original despatch shall be reproduced on the receiving-paper.

In Caselli's system the synchronism of the two sets of apparatus in correspondence must be *perfect;* and as only the ninetieth of an inch of the despatch is traced by one movement of the pencil, its transmission is not very rapid. Only one line-wire is required.

In the telegraph now working between Liverpool and Manchester Bonelli uses a sufficient number of pencils, arranged in

form of a comb, to copy the whole despatch by a single movement, and thus not only saves time, but, as perfect synchronism is unnecessary, avoids the necessity for elaborate arrangements for regulating the speed of the apparatus. On the other hand, each separate pencil must have a *distinct* wire, perfectly insulated from the rest, so as to reproduce only that part of the drawing or message over which it passes. Thus, originally, when it was proposed to produce elaborate copies like those of Caselli, an enormous number of wires were needed. This idea was subsequently abandoned, and the number of wires reduced to eleven, and lastly to five. The message is set up in ordinary type, and is placed upon a truck moving upon a miniature railway. The chemically-prepared paper is laid upon a metal plate, carried on a similar truck. Over the truck carrying the type is fixed a species of comb the width of the letters, having five teeth, arranged in such a manner that when the carriage moves the comb shall pass over the face of the type so as to touch their raised surfaces; and over the truck at the distant station is a similar comb, with the same number of teeth, resting lightly on the prepared paper. Each tooth of the combs is connected by a separate and insulated line-wire, so that when any one of the teeth of the sending-comb touches a part of the type a current is transmitted, which produces a corresponding mark upon the prepared paper.

The trucks are started at the same moment by the release of detents connected with electro-magnets, and are drawn forward by weights.

When all the five line-wires are in good order the system admits of marvellous rapidity, and legible despatches may be forwarded even when they are partially deranged.

As the blue mark of Bain and Caselli is produced by the dissolving away of the iron pencil, the ferrocyanide solution is not applicable to Bonelli's system, for it is necessary the teeth of the comb should wear equally; the teeth are therefore formed of platinum, and the solution is nitrate of manganese, which does not act upon the platinum.

The inventors of the automatic systems consider that messages may be prepared by the sender himself at his own office, and handed to the Telegraph Company simply for transmission. It may, perhaps, be doubted whether merchants or their clerks will give sufficient attention to the preparation of the punched ribbon, or write so distinctly on the Caselli tablets as to produce a good working copy; so that it may always be necessary that the staff of the telegraph should prepare the messages for transmission. Still the advantages of the system are obvious. The capacity of each wire is vastly increased; and as there need be no limit to the number of clerks employed in the preparation of and the translation of the despatches, the rapidity of transmission may be urged to the furthest. Machinery preserves its superiority to hand-labour even in telegraphing.

There is a limit to this rapidity. Induction lengthens the duration of each current, tending to connect the separate signals into a continuous line: and a contact of very short duration, unless aided by a powerful battery, is insufficient to charge the wire. These effects are not very apparent in short distances, but increase rapidly with the length of the line. It seems to us that, although greater accuracy may be attained, the telegraph service will not be as *regular* even as at present if fast automatic systems come into use. The wires will always be subject to derangement; and supposing the work done by each wire is doubled, the stoppage of a single wire will delay double the number of messages.

For the public, the *safest* apparatus is that which employs one wire only, and which works at a low speed. The cheapening of rates, however, will not permit the profitable use of such a system, and certainty must be sacrificed to price.

The value of a particular system must be estimated, not by the beauty or the singularity of its effects, but by pounds, shillings, and pence; that is, its cost, the expense of working and maintenance, its speed, correctness, and freedom from derangement. Every system has its own special causes of error and its own special faults, which are not always those which unprofessional persons would suspect, although, perhaps, on no subject do the ignorant give opinions more freely or with more confidence.

So much attention is now given to telegraphy, and so much talent is devoted to its improvement, that it is difficult to imagine what the next ten years may produce. The apprehension of Tawell was in its day a wonder; but how inefficient the power of giving a verbal description of the murderer, compared with that of forwarding his very portrait!

SISSLING'S ELECTRIC BAROGRAPH.

The chief novelty in this invention consists in the employment of electro-magnetism, to register the movements of the barometer and other meteorological instruments. This object is attained in the following manner:—

A hollow drum or cylinder, working upon a horizontal axis, is propelled step-by-step by means of a forked lever carrying an armature, which is alternately attracted and repulsed by an electro-magnet in its rear, and thus gives motion to a ratchet-wheel (containing twenty-four teeth) on the axis of the drum, propelling the latter forwards as often as the electric current is passed through the magnet. A spiral spring assists the armature in recoiling from the magnet, and it is in this recoil that the motion is given to the ratchet-wheel; for the forked extremity of the lever is so constructed, that when the armature is attracted, the tongue of the fork passes over the tooth of the wheel without producing any effect upon the latter; but when the current ceases, and the armature recoils, the other tongue of the fork, catching under the tooth of the ratchet-wheel, propels the drum forwards. A pointer is attached to one extremity of the axis, on the outside of the case containing the instrument, which, passing round a dial by the revolution of the drum, indicates the hour. Above the vertex, or fore part of the circumference of the drum, a brass or ivory slide is placed, one end being attached to a small support in such a manner as to admit of a free motion being given to the other extremity in a vertical direction. The free end of the slide is continued through a small upright slot at the extremity of the drum, where it is acted upon by a second electro-magnet smaller than the first, but working with the same wire. Along the major part of the length of this slide runs a slot, in which the writer is made to slide with the greatest freedom. This writer is composed of ivory, or other light, smooth substance, and being perforated in its centre, a minute ivory screw is inserted, the lower end of which carries a crayon point, which, when the current passes, and the small magnet attracts the slide, impresses a mark upon the paper of the drum.

The barometer, whose indications the instrument is intended to record, is placed at the side of the case containing the machine. From the float in the cistern of the barometer the motion of the column is communicated by a silken cord to the circumference of an extremely light ivory wheel, and from thence by a second cord to the writer before mentioned, thus converting the vertical motion of the barometric column into the horizontal one of the writer.

To the ordinary time-piece of the observatory is attached a simple commutator arrangement; so that on the completion of every hour a battery current is sent simultaneously through the magnets, and while the armatures are attracted, the tongue of the forked lever, as before stated, passes over the tooth of the ratchet-wheel, producing no motion of the latter; at the same time, the slide being attracted by the smaller magnet, the writer impresses a mark indicating the height of the barometric column upon the paper slip on the surface of the drum. The next instant the current is broken; and while the slide resumes its original position, the forked lever in its recoil propels the cylinder forwards, and thus the instrument proceeds registering hour by hour the indications of the barometer, and checking itself, as it were, by means of the pointer and dial; for by comparing the indicator of the latter with a watch or other time-piece, it may be at once seen whether the instrument is working correctly.

By the employment of electro-magnetism the inventor (Mr. W. Sissling, of Nottingham) is enabled to dispense with the usual clockwork arrangement, till now in use in registering instruments of this kind, thus greatly diminishing their first cost, while the greater simplicity of arrangement reduces the risk of getting out of repair to a minimum. The advantage is not so apparent when only one instrument is in use, because even this register requires a time-piece to act as commutator; but it will be seen that the wires from the magnets may be conducted to any number of these instruments compatible with the maximum power of the battery employed, and the commutating time-piece need not occupy the same room, or, indeed, the same building, but may be any distance from the instruments within the same limits, while the ordinary registering barometer requires a peculiar adaptation of clockwork for every separate instrument.

The barometer is the only instrument at present worked with these registers; but the inventor is actively engaged in rendering them applicable to many of the instruments in common use in the

observatory, and will not fail, as soon as success crowns his efforts, to give the public the benefit thereof. Mr. Sissling, being actuated by no other motive than the general good, has thrown open his invention unreservedly, and will be happy to render every information in his power concerning those minute details which cannot be conveyed within the limits of a paragraph, and places his address at our disposal for that purpose.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 188.)

E. Tyer, London (United Kingdom, 2,977), in the apparatus exhibited by him, uses only two visible signals, "train on line" and "line clear." He uses a bell or gong in connection with these signals in the manner presently to be described. Each of Mr. Tyer's receiving instruments has two pointers or needles, one black and the other red. Each of these can point to the right, where the words "line clear" are written, or to the left, where "train on line" is written. The red pointer shows the last signal sent, the black pointer the last signal received. Each instrument is provided with two sending buttons or keys side by side; that to the right sends the signal "line clear," that to the left "train on line." These two buttons also sound the bell or gong at the far station. Mr. Tyer's system requires that this shall sometimes be done without altering any of the pointers. To effect this the button which corresponds to the last signal sent must be pressed. An intermediate station has two of these instruments, one to communicate down the line, and the other up. The terminal stations have each only one instrument, the black pointer of which refers exclusively to the line of rails on which the trains run *from* that station. An example will best show the working of Mr. Tyer's system.

Let us suppose three consecutive stations, A, B, and C, with the down line running from A to C, and the up line, therefore, from C to A. A passenger train leaves A by the down line. The signalman at A must at once inform B by striking his gong twice. He could do this by pressing either button twice, but he must take care to use the button below the end of the red pointer, otherwise he would alter the pointer at B, which is not his object. When B hears the two beats on his gong, it is his duty to answer by pressing his left-hand button ("train on line"), which moves A's black needle and B's red needle both to the left, showing "train on line." A cannot alter this signal, and it is his duty to let no train start until B, on the arrival of the train, sends him a signal "line clear," which moves A's black needle to "line clear," as also B's red needle. When the train starts from B to C, B informs C of it by two beats on *his* gong; C answers by moving B's black *down* needle to "train on line," and B must allow no train to pass on the down line till C again puts B's black needle to "line clear." C has no black needle for the down line, for when the train is present he requires no warning that the down line is blocked.

The signals for the up train starting from C are exactly similar to those for the down line starting from A, except that a bell is used instead of a gong to prevent confusion. A has no black needle for the up line, but the red needle at A refers exclusively to the up line, and always corresponds in position to the black needle at B, from which the train is coming up. It thus shows at A whether the up line is blocked or open at B. In fact, the black needles always show the condition of the line on which trains run *from* a given station, and the red needle the condition of the line on which trains are running *to* the same station. The black pointer can only be altered in position by the distant station, but the red pointer can be moved at will in its own station. When A calls B to tell him that a down train is starting, he must take care to press the button which is under the end of the red pointer, otherwise he would alter the pointers as well as sound the gong. Thus, for one and the same signal, sometimes one and sometimes the other button should be touched, which to the writer seemed rather confusing. The system is, however, in extensive use, and the motion of the red pointer would attract the man's attention to any mistake he might make.

Mr. Tyer's system has one great merit. No man can alter the signal at his own station respecting the trains which have left it, and are between it and the next station. The black needle stands inexorably at "train on line" until the station in advance alters it. It is true that this alteration may be made accidentally from the other station, but it cannot be made wilfully at the station itself.

The connections are very ingeniously arranged, so that one line suffices for all signals between station and station. When the sending buttons are left untouched, the line is connected to the coils of the black needle, and thence through the bell coils to the earth. The batteries of that station are quite disconnected from the line. A signal current arriving along the line will then move the needle or not, according to whether the sign of the current corresponds or not to the previous position of the needle, but it will always sound the bell. When one of the buttons is pressed, it first presses back a spring, disconnecting the line from the black needle coils; it next brings the line into connection with, say, the positive pole of a battery, and at the same time connects the other pole of the battery to earth through the red needle coils. A positive signal is thus sent through the line, which does not move the home black needle or bell, but passes through the home red needle coils. If the other button be pressed, it equally breaks the contact between the line and the black needle coils, but puts opposite poles of the battery in connection with the line and earth through the red needle coils. The second button, therefore, sends a negative signal along the line, and passes an opposite current through the red needle coils to that given by the first button. All these contacts are made in a perfectly simple and direct manner.

Mr. Tyer's receiving instrument for the visible or needle signals is peculiar. His pointer is a little soft-iron needle hanging from an axis in the centre of a straight soft-iron electro-magnet, round which the received current passes, magnetizing the soft-iron core, and by its influence converting the little pointer into a north or south pole, according to the direction of the current. A little below the electro-magnet is a permanent horseshoe magnet, with the faces of its poles in a plane a little behind the soft-iron pointer, and with one pole—say the north—a little to the right, and the other, or south pole, to the left of the axis of the electro-magnet. Now, if a positive current be passed round the electro-magnet, converting the needle into, say, a north pole, it is strongly repelled by the north, and attracted by the south pole of the permanent magnet, and therefore either it is deflected to the left or remains in that position if it were there already; a negative current, on the other hand, will either move the needle to the right or maintain it there. When no current is passing, the little soft-iron pointer or needle simply remains in the position in which it was last placed, owing to the attraction which, in its unpolarized condition, it experiences from either pole of the permanent magnet indifferently. By this ingenious arrangement the permanent magnet is quite unaffected by the currents received, or even by lightning, although a permanent alteration in the signal might be effected by a temporary atmospheric current—an error which could not arise where permanent currents are used to produce the permanent visible signal. The general arrangement is simple, and not likely to get out of order. The instrument can be adjusted to work with stronger or weaker currents by sliding a keeper along the permanent horseshoe magnet, leaving more or less of its magnetism to attract the pointer. Mr. Tyer's signals are extensively used on many lines of railway.

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit a magneto-electric railway alarum, used to announce the departure of each train from each station. These alarums are, in Germany, placed all along the line from one station to the next, at distances of from 1,000 to 1,200 yards apart. They consist of a large iron bell, 18 inches in diameter, struck by a heavy hammer driven by clockwork, which is started by the electric current. The signals can be heard at least 600 yards off. When a train starts from any station all the alarums between it and the next stations are sounded simultaneously. The currents are obtained from a magneto-induction system similar to that used in Messrs. Siemens' step-by-step instrument, but much more powerful; the coils and armature are placed between the poles of twenty-eight powerful horseshoe magnets, and are driven by a handle and belt.

The clockwork has several valuable peculiarities. The received current releases a delicate detent by an electro-magnet in the usual way. This detent does not directly start the clock, but allows a weight to fall, which knocks away a much heavier catch used to hold back the clockwork, the wheels of which then start, and continue to run until the hammer has struck a given number of blows. The clockwork then replaces the two detents and releasing weight in their former positions, and stops ready to receive another signal. About ten of these instruments are usually placed in circuit.

Lieutenant E. Vincenzi, Turin, H. M., Class V. (Italy, 1,006), exhibits a plan by which a railway train in motion may be communicated with at short intervals through a temporary contact

made between a spring on the break van and certain long bars placed every 1,000 yards along the railway, and connected with the two stations on either side by a line wire.

Cheyne & Moseley (United Kingdom, 2.281) exhibit a plan by which they propose to register the passage of each train at given points by marks on a strip of paper moved nearly uniformly along, as in the Morse recorder, and moreover dotted at fixed intervals by currents from a time-piece. They also propose to register every change in the position of danger signals, switches, &c., in the same manner.

11. *Lightning Dischargers.*

Among the adjuncts of a telegraph line we may here mention the lightning dischargers, of which a large variety is shown.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2,864), exhibit a rarefied air lightning discharger. This apparatus, invented and patented by Messrs. Bright in 1852, consists of a vessel exhausted to such an extent that any current of a tension* likely to prove injurious to the telegraphic instruments, or to a submarine cable, will find a ready passage from the line wire connection through the rarefied air to the earth connection, whereas the less intense currents used for working the telegraph will not pass across the rarefied air. The tension which will produce a discharge can be regulated by the extent of exhaustion in the vessel, and by the distance between the series of opposed points, in connection respectively with the earth and the line. The resistance to discharge through the exhausted air can be reduced far below that opposed by the thinnest practicable film of air between the points of the ordinary lightning dischargers, and the protection afforded is proportionately increased. No measurements of this resistance of the rarefied air appear, however, as yet to have been made. The communicating points are in this form perfectly protected against dust, &c., as the vessel is hermetically sealed. Abroad this is known as Bianchi's discharger, but the writer can find no mention of it prior to 1852.

Digney Brothers, M. (France, 1,414), and Bréguet, M. (France, 1,413), both exhibit two very common forms of lightning discharger. In one a couple of serrated plates are simply fixed on a board with the points of the teeth very close together; one plate is in the line circuit and the other connected with earth. The second form has two parallel plates facing each other, and each holding three pins with platinum points, which can be adjusted so as very nearly to touch the opposite plate; the plates are connected as in the first form. These dischargers are used in conjunction with a coil of fine wire, intended to be burnt by the passage of any very intense currents, as in the form exhibited by Mr. Walker in 1851. This invention of Mr. Walker's is now very generally adopted in all countries.

Siemens, Halske, & Co. (United Kingdom, 2,959) exhibit a lightning discharger which differs entirely from any other exhibited. It consists simply of two massive, flat, rough, metal plates thinly coated with varnish. One of these is in connection with the earth, and the other is in circuit with the line; one is simply laid on the other, but separated from it by four small thin slips of vulcanite, leaving a thin film of air between the two surfaces. When several lines enter the station, one large plate is in connection with the earth, and each line has its own small plate insulated from its neighbours, and resting on the large earth plate. The lightning is found to pass readily across the air and varnish at one or more of the many points of extremely close proximity which occur between the surfaces. The plates are frequently fused together by the discharge. Messrs. Siemens assert from long experience that this cheap and simple contrivance is preferable to any known arrangement of discharging points.

12. *Domestic Telegraphs.*

The review of the apparatus used in connection both with land and submarine telegraphic lines is now concluded, and, in order to complete the notice of signalling instruments, it remains only to mention the so-called domestic telegraphs, intended to supersede the ordinary bells in large public and private establishments. Several forms of domestic telegraph were exhibited in 1851, but they have as yet met with little success in this country.

P. D. Prud'homme, Paris, H. M. (France, 1,402), exhibits instruments which have been adopted with success in France, in large hotels and other buildings, where the usual system of bell-hanging would have been almost impracticable. There is no special novelty in M. Prud'homme's bell, which is the common "trembleur," sounded by the voltaic current from a couple of cells, so long as the circuit is completed, by pressing a button. Besides the bell, M. Prud'homme uses visible signals, consisting of letters or words on a disc of paper, moved in or out of sight by the deflections of a permanent magnet between the poles of two electro-magnets under the influence of reverse currents. The whole arrangement is simple, effective, and not likely to get out of order; a bell and visible signals are generally combined. The person answering the bell removes the signal back to its normal position by pressing a button, which sends a current back through the circuit in the opposite direction to that sent by the first caller.

The prices quoted by M. Prud'homme are extremely moderate, and were it not for the trouble of keeping the battery in order, electric bells might be introduced with advantage even into small establishments. The battery used is said, however, to work for many months without being touched.

The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2,978) exhibit a domestic bell rung by a magneto-electric current, thus dispensing entirely with the battery. The depression of a handle transmits the current in the usual way, and releases the detent of an alarum.

IV. Philosophical Instruments, or Instruments used in Experimental Research.

1. *Apparatus for testing Submarine Cables, &c.*

Messrs. Siemens, Halske, & Co., London (United Kingdom, 2,959), and Messrs. Siemens & Halske, Berlin (Prussia, 1,413), both exhibit resistance coils arranged with a modification of Wheatstone's bridge or balance in a convenient form for testing the resistance of the conductor and insulator of submarine cables. Professor Wheatstone's bridge or balance is a combination of four conductors with a galvanometer and a battery, in which the galvanometer needle remains undeflected when the resistances of the four conductors form the four terms of a simple proportion. The arrangement is sometimes called Wheatstone's parallelogram, but the geometrical relations of the sides of a parallelogram are not those of the four conductors in the bridge or balance. Neither can it be strictly called a differential arrangement, except in the particular case in which the conductors form two pairs each composed of two equal resistances. On the whole, the name of electric balance is, perhaps, the most accurate.

The conductor, the resistance of which is to be tested, is so placed in the balance as to form the fourth term of the proportion, and its resistance is determined in terms of the three others, by varying one or more of them till the galvanometer remains undeflected, when the battery circuit is completed. This determination can be made in two distinct ways: first, by varying the ratio of the two first terms of the proportion; secondly, by varying the value of the third term. Both these plans are adopted in Messrs. Siemens' testing board. The conductors, which we have called the first and second terms, can be chosen at will, so that their resistances shall be equal, as one to ten, as one to one hundred, as ten to one, or one hundred to one. Moreover, the equality may be either equality between units, tens, or hundreds.

A set of resistance coils, varying from a single unit to ten thousand units, is so placed as to form the third term of the proportion. The test is made by first selecting the most suitable ratio between the first and second terms, and then altering the resistance of the third term until, when the battery is put in circuit, the galvanometer needle remains undeflected. The resistance of the conductor tested will then be either equal to that of the resistance coils of the third term, or it will be a decimal multiple or sub-multiple of that resistance. By this arrangement we can measure resistances one hundred times larger or smaller than could be compared with the set of resistance coils, if the only ratio between the first and second terms were that of equality. All the connections which require to be altered are altered by means of conical plugs fitted between the two brass terminals to be joined. The resistance coils are all permanently connected in series, and those not required in circuit are simply short-circuited by plugs. The insulation of the various parts is effected by vulcanite or ebonite, and the ebonite is mounted on a slate slab. From the above it will very clearly appear how the resistance of the conducting wire of a cable is measured. This wire is simply connected so as to form the fourth term as above; one end is connected with the board, and the other connected with the earth.

* By the word tension is here meant the difference of potential from that of the earth in the neighbourhood of the instruments.

The resistance of the insulator to conduction across itself, from the copper conductor inside to the water outside, is tested in exactly the same manner, and with the same connections, simply insulating the second end of the copper conducting wire of the cable, and if necessary changing the ratio between the two first terms. The insulating sheath is then simply in the position of a conductor of high resistance, one end of which, the inner surface of the sheath, is connected with the proper terminal of the board by the internal copper conducting wire (of comparatively insensible resistance), while its other end, the outside of the sheath, is immersed in water, and thus connected with earth, to which one pole of the battery and one end of the resistance coils (third term) are also connected. The insulation of a submarine cable depends on the relative resistance of the copper wire to conduction along itself from one station to another, and of the insulating sheath to conduction across itself from its inner to its outer surface. When these two resistances are known, a formula based on Ohm's law gives the proportion between the current received at the far end and that sent into the cable at the near or signalling end, showing the loss by the way. The resistance of the sheath, measured as above, also allows us to calculate directly by Ohm's law the current which would flow across the sheath with a given battery or rheomotor when the further end of the conductor is insulated. This current, as shown by the deflection of a galvanometer, is frequently called the loss from defective insulation, instead of the loss first mentioned. So long as the materials and dimensions of an insulated core are alike the loss, as last defined, will be simply proportional to the length of the cable, but will, of course, vary with the battery, the galvanometer, and the dimensions of the core tested, even when the material remains the same.

The *resistance* of the sheath is, on the contrary, independent of the battery and instruments employed, and very simple reductions taught by theory and practice permit us to deduce from the resistance observed the specific resistance of the insulating material—that is to say, the resistance of the unit length and section of that material. From this specific resistance we can conversely deduce the resistance of any sheath of any length and thickness, and the loss of current, whether defined in one or other of the two ways described above. The first insulation tests made on submarine cables were tests of the loss according to the second definition, but as no record was kept of the electro-motive force of the batteries, or the signification of the deflections of the galvanometers, these tests were nearly useless for the purpose of comparing one cable with another of different dimensions, but at best served to show whether, during the manufacture of the cable, the later portions were similar to those first made. At present, on the contrary, the *resistance* of the sheath is very generally measured, and by the specific resistance deduced from these measurements the excellence of the different materials at all different temperatures, and the relative perfection of the different cables manufactured by different makers at different times, are very accurately made known.

The measurement of the resistance of the sheath, or, as it may be called, the insulation resistance of a cable, has a second object, of perhaps still greater importance than the determination of the specific resistance of the material. A fault diminishes the resistance of the sheath, and conversely too low a resistance in any section of a cable indicates a fault, and is one of the chief means by which faults are detected. A fault here means the presence of any foreign substance of less resistance than the insulator in the sheath, joining the water outside and the conductor inside; thus a fault may be a hole or cut, which becomes filled with water, or a nail driven through the sheath to the copper, or simply dirt and other impurities in the insulating material.

Messrs. Siemens' arrangement is by no means the only one by which the resistance of the insulating sheath can be obtained. It may with proper precautions be obtained even from the loss (according to either definition) shown by the simple deflections of a tangent or sine galvanometer, or by differential galvanometers used in connection with resistance coils; but Messrs. Siemens' arrangement is simple, accurate, and effective when used for cores of some knots in length, for which alone it is intended.

(*To be continued.*)

MR. L. W. COURTENAY (late secretary of the Submarine Telegraph Company), after a short visit to England, returns to Constantinople with the next mail.

MR. COOKE'S PAMPHLET OR SKETCH OF 1836.

(*Continued from page 190.*)

IN reproducing in our columns this remarkable and highly-interesting sketch by Mr. Cooke, our object is to enable our readers to become acquainted with the early history of the electric telegraph, and of the labours of those to whom we are indebted for its practical realization. The author of the sketch described in a lucid and forcible language the great disadvantages of the system of telegraphing then in existence, and the manifest superiority for all purposes of communication of the plan he then proposed; yet what years of labour and solicitude rolled on ere his project found favour in the land which he and his illustrious coadjutor have since so immensely benefited! For a period of six or seven years the prospects of the electric telegraph were as gloomy as they are now brilliant. Viewed as a "philosophic toy," incapable of practical application, capitalists could not be found willing to embark in the undertaking. Government required no speedier means of communication than it already possessed in the old semaphore. Under such circumstances, we can easily conjecture the nature and extent of the difficulties to be surmounted in preparing the public mind to receive the project of an electric telegraph as one capable of practical application.

To proceed to the second subject of consideration proposed, viz., the providing a sure, speedy, and simple method of discovering the injured point in every case.

For this purpose short branches will be given off from the main wires, opposite to turnpikes on common roads, and station-houses* on railroads, into which buildings the extremities of the wires will be carried, and there secured in a lock-up box, or closet in the wall, of which the district-inspector will have the key. He will be furnished also with a simple electro-magnetic instrument about the size of a watch, containing a poised magnetic needle; upon connecting this instrument with the terminations of the branch wires, or with the main wires themselves, in the manner described in the note (the telegraphs being set as directed), it becomes immediately evident, by the deflection of the needle, on which side of the place of experiment the wires have been injured. As soon as the connection between two telegraphs is found to be broken, the inspector will proceed to discover, by successive experiments, the two consecutive turnpikes, or station-houses at which the effect on the needle is reversed. The injured point must evidently be somewhere in the interval between them; his next step will be to examine the intervening ground, to discover if there be any external marks to direct his further search; if none appear, he will divide the interrupted distance (which we will assume as 12 miles), and cause a hole to be sunk to the conducting trough, when the former experiment will be made upon the main wires. This halving of the intervening space, if repeated 12 times, will reduce the unexamined distance from 12 miles to 5 yards; whilst at each examination, the attention being directed nearer and nearer to the object of search, the probability of detecting external marks of violence will be increased. Thus, a very few hours from the discovery of the interruption will, under the most unfavourable circumstances, be sufficient to admit of the injury being detected and repaired.

Since such injuries could only be of very rare occurrence, the ready method thus afforded for detecting and repairing them, renders this very trivial liability unworthy of further consideration, and forbids its being viewed as any objection to the system.

Having obviated these apparent difficulties, we now proceed to notice some further advantages arising:—1st. From the nature of the instrument. —2ndly. From the extended application of telegraphing which it renders practicable.

Hitherto, *signals*, very slightly differing from each other, have been used in telegraphing, to represent either the letters of the alphabet, or numbers, corresponding with the signal key. In the electro-magnetic telegraph, the characters represented amount in all, as has been already stated, to 60, consisting of 22 letters, viz., A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, R, S, T, U, W, X, Y; 10 English digits, viz., 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, representing amount; 10 numbers, viz., I., II., III., IV., V., VI., VII., VIII., IX., O., in reference to the signal key; 14 symbols, viz., £, *s*, *d*, ÷ ?, ?, ,, ,, ,, ,, &c., &., (private symbol,) (government symbol,) and any other 4 symbols which may be found the most convenient for practical purposes, making 60 the total. NOTE.—It is found convenient to repeat the ? and ,. ÷ is a fractional sign, as 1 ÷ 2, or ½.

From 1,000 to 1,500 of these characters may be represented in an hour, so that with an extensive and well-selected compilation of sentences, questions may be put and answered, advice asked and given, and consultations of every kind carried on with no further loss of time, and

* By station-houses, may be understood all buildings connected with railroad lines, whether depôts, &c. near towns, or watch-houses where the main-roads are crossed, &c., &c. These generally occur at far shorter distances than 12 miles.

sometimes even with less, than would be requisite for making the same communications to the deaf and dumb, by talking on the fingers.

This advantage, which is great even at comparatively short distances, increases incalculably in importance when the places are very remote from each other.

The precision and certainty of the instrument are also deserving of observation. It is worked, in a very simple manner, by 16 keys or stops; each of these keys has the particular characters inscribed upon it, which the instrument can be made to represent by its action, and these characters are arranged in such positions as to indicate the direction in which the key must be moved for the representation of each. The greatest possible security is thus afforded that the attentive signaliser will, without fail, represent the character which he intends. Again, each character is about half-an-inch in diameter, so as to be perfectly distinct, and only one character being visible at a time, precludes any doubt in the clerk receiving information, whose sole business it becomes to copy down the several characters which are successively presented to his eye. Lastly, this one character being simultaneously represented on both instruments, the signaliser, if by accident he has laid his hand upon a wrong key, immediately observes his error, and will correct it by the following signal.

Inscrutable secresy is, obviously, of primary importance in the mass of telegraphic correspondence. This may, on a *primâ facie* view, appear a difficult object to attain, where the symbols are seen by a number of persons at the same time, without each corresponding party having a private signal-book, but the accompanying "Round-Robin" cypher* will at once show, from the innumerable changes of which it is capable, that a published signal-book may be employed on the most private occasions. These changes depend upon the fresh relative arrangement of the circle containing the letters, to that containing the figures, each time of the cypher being employed, however frequently it may be required during the day.

To illustrate this, suppose a card published with each signal key, with the letters and the numbers in the order of the annexed cypher. A London banker, in the habit of communicating on all extraordinary occasions with his country agents by telegraph, would furnish each of them with a private memorandum, of which he would keep a copy, to this effect (in adjusting the cypher).

Mr. J., Liverpool, No. in signal key, 3742, set 1st signal given to the day of the month.

Mr. P., Glasgow, No. 2314, set 2nd signal to the day of the month.

Mr. D., Edinburgh, No. 143, set letter H to the day of the month.

Mr. X., Dover, No. 415, set 7 to odd days of month, VII. to even, &c.

And so on with an endless variation, to which the most extensive correspondence could give no clue.†

Suppose the correspondence then to run thus:—

(Private symbol) L L 3742 }
(Private symbol) G 2314 } 782,641,39 ? £42 5 6½ Stolen.

The cypher transpositions would stand thus on the

1st January, { if to Mr. J. / if to Mr. P.
2nd January, { if to Mr. J. / if to Mr. P.

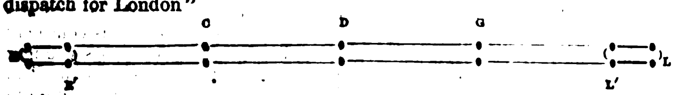
(Not filled up in the manuscript.)

At first this may appear difficult to transpose from the cypher card, but a very little practice gives great facility.

We proceed to consider the application of this system to the affairs of Government; of the commercial world; and of the private individual.

I. Application to the affairs of Government:—It will be generally acknowledged that an enterprise of this description, though carried into execution by a company, should always be under the control of the Government, that in case of dangerous riots, or popular excitement, the earliest intimation thereof should be conveyed to the ear of Government alone, and a check put to the circulation of unnecessary alarm. From the construction and character of the Electro-Magnetic Telegraph, great facility is given to the exercise of this control when requisite, without interfering with the enjoyment, by the public, of its fullest advantages on ordinary occasions. Let Government be supposed in possession of a distinct telegraph at either end of the line, when, by a single movement, the communication between the public telegraphs may be cut off.

Suppose E, L to be the public telegraphs at Edinburgh and London respectively; E′, L′, the Government telegraphs at those places; and C, D, G, telegraphs at intervening towns; when the signal, "Government dispatch for London"



is passed from E′ to L′, the connection between E′ and E, and between L′, and L will be immediately broken off, as the act of giving the signals, "Government dispatch for London," from the telegraph at E′, breaks off the communication between E′ and E; and, as the Government telegraphs will be differently arranged from those in public use, the communications would be unintelligible at the places C, D, G. On lines along which Goverment dispatches are most frequently transmitted, it might be desirable to lay down a distinct set of wires for that use, which would also diminish the risk of the communication being entirely interrupted by the accidental breaking of a wire. The wires of the public telegraph might then pass through the Government office, and be applied to the Government instrument at pleasure, when the usual arrangement of the signals could be restored. Commanding, by these means, immediate and sole intelligence of disturbances, &c., in different parts of the kingdom, the Government would be enabled, in case of disturbances, to transmit their orders to the local authorities, and, if necessary, send troops for their support, whilst all dangerous excitement of the public might be avoided.

II. Application to commercial affairs.—The advantages under this head are no less comprehensive and important. An immediate knowledge of the daily state of all the important markets, &c., would place the most distant cities of the kingdom on a footing in their mercantile transactions with the capital. The daily state of the money market, so eagerly expected on the Stock Exchange of London, would be looked for with equal anxiety at Liverpool, Glasgow, and Newcastle, at the same moment.

The security and confidence inspired by an actual knowledge of the existing state of things, would give a fresh spur to activity in all honourable mercantile transactions; while the unfounded reports now circulated by the swindler could no longer produce their effect. The capitalist of Glasgow might, without fear of an unfavourable change of price taking place during the interval, transmit to his agent in London, orders for the immediate sale or purchase of stock or shares; and the banker of the country, when pressed in time of panic, might be preserved from stopping payment, by assurance from the capital of extended credit. The offerer of false bills, on the other hand, would be in more dangerous circumstances, when his guilt might so soon be proved; and the culprit, escaping from justice, might be anticipated by intimation to the authorities on the coast.

For security against unfair dealing and neglect, copies of all communications given in for transmission at the office would be kept for the reference of subscribers, with date of the day and hour at which they were received, and the originals, countersigned as entered, would be returned; where unjustifiable delay or carelessness in forwarding the same was proved, the clerk would be subjected to punishment. This and other obvious regulations (not necessary to transcribe here), would ensure the same accuracy in the telegraph, which has established the character of the Post Office.

III. Application to the affairs of individuals.—The cases in which the convenience of individuals would be effected are innumerable; and perhaps there are few persons, however generally unconnected with the transactions of the busy world, who would not sometimes be spared either a lengthened epistolary correspondence or an expensive journey, by a few short communications through the telegraph. The comfort of friends and relations, far distant from each other, would often be materially involved, especially in cases of sickness; and it may not be too much entering into detail to specify that particular instance, where sickness appears hastening towards a fatal termination with such rapidity that a final meeting is without the range of ordinary means. Though the application of the telegraph to private affairs is less dazzling than that to Government and commerce, it is, perhaps, not less intrinsically valuable as equally tending towards the one and only justifiable object of all establishments—the aggregate of comfort and happiness to the nation. It may here be observed, that should it at any time be desirable for the Admiralty, in their communications with vessels lying off telegraph ports, to convey their despatches direct during the night, the apparatus in ordinary use, conveniently situated facing the sea, may, by a peculiar adaption of the hydro-oxide lime burner, arranged for this instrument, extend their correspondence many miles across the water. Even His Majesty's navy might be furnished with instruments of a simpler arrangement than that proposed for land service, to communicate signals during the night, the action of which would not be interrupted by the motion of the vessel during bad weather. For short distances of a few miles, a powerful argand lamp would answer this purpose effectually. We will specify one further instance nearly allied to many others, in which this telegraph might be advantageously employed. It is observed by Dr. Lardner, in his work on the steam engine, at the 219th page, when speaking of the inconvenience to which locomotive engines are exposed in surmounting inclined planes on railways, that "a subsidiary, or assistant locomotive engine, may be kept in constant readiness at the foot of each incline, for the purpose of aiding the different trains as they arrive, in ascending. The objection to this method is the cost of keeping such an engine, with its boiler continually prepared, and its steam up. It would be necessary to keep its fire continually lighted, whether employed or not; otherwise, when the train would arrive at the foot of the incline, it should wait until the subsidiary engine was prepared for work." This plan is adopted.

How soon would the proprietors of railroads be repaid for laying down wires along a few miles of road leading to such ascents, by which timely intimation of the approaching train might be forwarded to the engine-man, with notice to prepare? and how effectually would this remedy the costly inconvenience described?

Lastly, consider the sources whence a revenue, adequate to defray the

* This cypher has been lost.

† Short expressions, such as "I," "and," "to," "by," "of," "you," should always be avoided in cypher correspondence, as affording an easy clue to a certain number of letters.

original outlay and current expenditure of such an enterprise, may be derived. If a company undertake the execution, under the control of Government, a proportionate remuneration for the forwarding of official dispatches may be expected from that quarter. In each town where a telegraph was established, various classes of subscribers would be admitted to the privilege of receiving and forwarding their private correspondence, and of being made immediately acquainted with the general news of the day. These might consist, 1st.—Of perpetual subscribers or shareholders, admitted to the subscribers' room, where all general, political, and mercantile news would be published as soon as received. 2ndly.—Annual subscribers. 3rdly.—Temporary subscribers for some special purpose. 4thly.—The occasional subscriber for a single dispatch. Each of the three former, in addition to his subscription, would pay, on employing the telegraph, according to a fixed scale, proportioned to the length of the dispatch and the class to which he belonged.

If any interference, which an extensive establishment of this telegraph might create with the Post Office, be viewed as an encroachment upon the revenues of Government, it will be remembered that communications by telegraph may be taxed as well as those by post; and as this interference would be almost insensible in any case, Government would gain, not lose, by the event.

The writer does not propose to go into a lengthened statement of the minor details of his plan on the present occasion, but to give only such a sketch as will enable the reader to form a general idea of it as a whole.

It may, however, be desirable to explain the nature of the signal-key which he purposes employing, although perhaps offering nothing new in its design.

The numbers in reference to the signal-book, it has already been explained, will be formed on the telegraph, in the Roman character (or else broad printed type) for the purpose of distinction.

The signal-book or key might advantageously have two sets of numbers; the first, for general use, in reference only to daily reports, sentences, words, &c.; the second, which would be indicated by the signal (private) preceding them, might be appropriated to the names and directions of subscribers. Hence, a telegraphic notice commencing with (private), followed by a number, would intimate that the symbols following, after being taken down and copied into the day-book, should be forwarded in the usual way to the person whose address that number signified; when followed by the signal (express), an additional charge would be made for despatching it on the instant. An abbreviated mode of spelling (a kind of short-hand) would generally prove more expeditious for the public office than the employing numbers to express single words. The towns would be most easily recognised by their initial letters; and when on the same line two telegraphic towns commencing with the same letter occurred, one might be designated by both the first and last letter, as L. for London; L. L. for Liverpool; N. for Newcastle; N. M. for Nottingham, &c. A clearly-printed list of these abbreviations and their meaning, together with the numbers of daily reports, might be fixed before the clerk attending the telegraph, for ready reference. When, if at Leeds, on the York and Liverpool line, he saw, after the alarum had been sounded and been answered, the letters L L. follow on his telegraph, he would leave the further attendance on the signals to his compeer at Liverpool.

The duties of a clerk of the telegraph would be extremely simple, requiring only accuracy and attention in noting down and transmitting notices with a certain degree of expertness, easily attained in working the instrument. These qualifications are frequently possessed, in a remarkable degree, by a very deserving class of persons, to whom our state of society has hitherto assigned no congenial occupation. The deaf and dumb might, in the telegraphic department, find employment peculiarly suited to their education and powers. Accustomed from their infancy to abbreviate as far as possible, by signs, their symbolic language, they would quickly attain a degree of conciseness in spelling, which, in addition to the omission of the smaller words, would enable them to transmit, with astonishing rapidity, a lengthened despatch; whilst a habit of attention, enforced by their infirmities, would be favourable to the accurate performance of their duties.

The idea of uniting a great political and mercantile enterprise with a charitable object may excite a smile, but cannot diminish the value of the undertaking in the eyes of those whose support the writer is most anxious to ensure. It may be observed, that a method as effectual as the alarum for those who can hear, may be employed in connection with this instrument, to awaken the deaf from the soundest sleep.

A general outline has now been given of a system by which the knowledge of passing events may be propagated instantaneously to distant parts, together with a view of some leading advantages which may reasonably be expected to result therefrom.

To what the introduction of this system may eventually lead, the writer does not venture to predict, but concludes these observations with the following quotation from Dr. Lardner's work already mentioned, a passage which may be applied to the action of the Electro-Magnetic Telegraph as forcibly as to that of the steam-engine, and, indeed, corresponds most happily with the united action of both. It runs thus:—"The moral and political consequences of so great a change in the powers of transition of persons and intelligence, from place to place, are not easily calculated. The two advantages of increased cheapness and speed, besides extending the amount of existing traffic, call into existence new objects of commercial intercourse. The concentration of mind and exertion, which a great metropolis always exhibits, will be extended, in a considerable degree, to the whole realm. The same effect will be produced as if all distances were lessened in proportion in which the speed and cheapness of transit are increased. Towns at present removed some stages from the metropolis, will become its suburbs; others, now a day's journey, will be removed to its immediate vicinity; and business will be carried on with as much ease, between them and the metropolis, as it is now between distant parts of the metropolis itself."

(To be continued.)

THE ATLANTIC TELEGRAPH.—OUR RELATIONS WITH AMERICA.

On Friday evening last the friends of the great enterprise for connecting the Old World with the New, by the agency of the Electric Telegraph, dined together, on the invitation of Mr. Cyrus Field, at the Palace Hotel, Pimlico. There were present:—His Excellency the American Minister, Lord John Hay, Hon. R. Grimston, Mr. Bright, M.P., Mr. S. Gurney, M.P., Mr. G. P. Bidder, Captain Osborn, R.N., &c.

The Chairman (Mr. Cyrus Field) having proposed the health of his Excellency the American Minister,

Mr. Adams replied, and, in the course of his observations, said he felt most thankful for the kind way in which the company had received the allusion made by the chairman to the humble efforts which he had been making during the last three years, to preserve harmony between two nations of the same race, the same language, and the same religion, at a time when there was great danger that they would differ. In the little observation which he had been able to make during the period he had had the honour to hold the position which he at present occupied, there was one thing which struck him more than anything else had, and that was the existence of prejudices on both sides of the Atlantic, which only required for their removal a little more familiarity between the two peoples. (Cheers.) He had seen statements made in the public prints of this country with respect to the acts of his country, which he was sure would never have been made had those who gave expression to them personally known the truth with respect to them. (Hear, hear.) Likewise, on the other side of the Atlantic, there were newspapers which indulged in certain statements with respect to Great Britain, which he was sure they would have never uttered had they truly known Great Britain, and the true feelings of the British people. It was in the cause of civilization most important that the harmony between the two nations should be maintained unimpaired, and he knew no better means of doing so than the establishment of the electric telegraph between the two countries—a project, to the execution of which Mr. Field had devoted his talents and his life, and which, should it be effected, would rank as the most memorable and the most glorious event in the history of the world, and secure an immortality for the reputation of their worthy host. (Cheers.)

The Chairman, in proposing the health of the hon. gentleman the member for Birmingham, took occasion to say that he very much wished his hon. friend would visit the United States, where he promised him he would be received with an ovation such as no man living ever received. The only danger was that all the male children born in the course of the year in which he might so honour them would be named after him, and, instead of being Browns and Joneses, they would be all John Brights.

The toast having been enthusiastically honoured,

Mr. Bright said:—Gentlemen, I might very easily rob Mr. Field of the originality of the statement he has made of what might happen were I to pay a visit to the United States. I have in the course of time received many letters from gentlemen in his country, and one of them did say there were several penalties I should have to endure as the consequences of my visit to America, and one of them was, he thought, that nearly all the children there would have to be called after me. (Hear, hear. and laughter.) If this and a great many other dreadful things which he thought would follow my visit be true, I am, I think, very prudent in staying in this country. (Hear, hear.) I have never been in America, but for thirty years, which is a long time to look back to, I have had a strong wish to go there; but most of us Englishmen find so much to do in the conduct and management of our regular business, that a six months' absence is not a thing easy to accomplish. Englishmen are, I think, I will not say more attached, but certainly much more tied to their homes than Americans are. However, when Mr. Field is able to tell us that the war is over—(hear, hear)—that the Union is restored—(hear, hear)—that there are none but free men on his continent—(hear, hear, and cheers)—if I could say I might be a few years younger than I am likely to be when that happens, I might perhaps be induced to promise to pay a visit to America. I do not know how many of those in this room are Englishmen, nor how many are Americans, nor is it at all necessary to discriminate between them, but it is, I think, worthy of notice that you cannot tell one from the other. (Hear, hear.) That is not an unreasonable thing, seeing that our ancestors were your ancestors. (Hear, hear.) But it is a very provoking thing, if anything be so, that there should be people who would make us foreigners and strangers to each other. (Loud cheers.) I am convinced that it is possible to go through the United States, and select a number of gentlemen, English and Americans, equal

to the fifty or sixty gentlemen who are now present, and that if you put them together, one half with the other, you would find them just as friendly disposed towards each other as we are, and just as able to enjoy the good things provided for them. (Cheers.) There would not be among them the slightest disposition to quarrel one with another. (Hear, hear.) On the contrary, they would begin to think that all that has been said to create a hostile feeling between them is false, and then the lies and frightful calumnies which a great newspaper in this country—(hear, hear)—and another great newspaper in New York—(hear, hear)—treat both hemispheres to would no longer be regarded. (Cheers.) There are some persons in England very jealous of America. They think it is too big to govern itself—to be under one Government. They—the subjects of a State which governs an empire of 160 millions of people of a different race, some thousand miles away—they, I say, have a profound conviction that thirty millions of people, of the same race, language, and religion, are really too large a population to be governed by themselves and to constitute one State. (Hear, hear, and cheers.) This national jealousy is very stupid, to say the least of it. (Loud cheers.) When the grandfather of the distinguished guest beside me was here in the same capacity which he now occupies, he was here in times of great animosity, in times of great displacement of old feelings, and in times of great national irritation—(hear, hear)—for the American colonies had just then emancipated themselves. After the war of 1812 his father came here in the same capacity, and he curiously enough also came in for a portion of that kind of national irritation, the result of the war not having been very flattering either to the policy or the forces of England; and now our friend is here at a time when, although we are not at war, yet when war is producing very unfortunate results here, especially in regard to one very important branch of commerce, and is stirring up memories which had better been buried for ever. (Loud cheers.) From all this there comes—there comes from men, some partly ignorant, some suspicious, men of contracted intellect, totally ignorant of what makes the great and true glory of nations—a jealousy of the United States. (Hear, hear.) In ancient times it was considered the glory of nations to plant powerful colonies, and they did not glory the less in them because they became independent. (Cheers.) The United States have ceased to be our colonial possessions, and are now truly an independent nation, but still they are our colonies. (Cheers.) What, then, can be more contemptible, and flying in the face of all that is great and glorious, and all we are taught in history to value, than that we should feel jealous of the great nation on the other side of the Atlantic, planted there by ourselves? (Cheers.) We have achieved whatever glory we are entitled to for having been able to carry everything good in this country to a higher point of excellence than any other country of which we are told in history ever did. (Hear, hear.) We have lately heard a great deal about the advantages of a universal language, and if I am disposed to talk often I am not the less disposed to listen and be taught, and I know nothing more irritating and irremediable than the story we are told of what took place in the tower of Babel, by which men are supposed to speak in different tongues not mutually understood; but in the United States there are thirty millions of people of the same race as ourselves, professing the same religion and speaking the same language, so that when peace is restored, the Government re-established, schools and classes enough open for the general and religious instruction of the people, and freedom universally established, there will be a vast field opened for the development of commerce, civilization, and Christianity, and the population will every ten years grow to a degree that even in the lifetime of our children the English language will be spoken by 100 millions of free people. (Hear, and cheers.) What a magnificent contemplation that is. (Renewed cheers.) If I chance to go further, to the Australian colonies, which under the blessing of free institutions are becoming great and populous, I find that there the English language is spoken as it is spoken in the United States, and, again, if I come to our vast dependencies in India, inhabited by 150 millions of people, among whom the English language is daily and yearly extending its influence, so that by means of the care of schools and a good educational system we shall have the educated people of Hindostan twenty or thirty years hence, should the connection continue so long, speaking the English language. (Cheers.) Finally, I come to South Africa, and there the English language is making its way also among various different nations, so that we see that this language of ours, in which some of the greatest and most eminent men who ever lived have written and spoken, is universally extending itself by the help of commerce and civilization, until it promises to belt the world. (Cheers.) I want, then, to know why there should be any persons inclined to keep up cavil, to excite and stimulate jealous passions and a hostile mind between two nations speaking this language. (Cheers.) I cannot conceive any man more an enemy, not only to his country and the cause of freedom, but also to humanity itself, than he who lends himself to create and foster jealousy and animosity between the United States and this more ancient English nation. (Cheers.) I thoroughly agree with what Mr. Adams has said with regard to the political importance of that great undertaking in the cause of which we are this evening assembled; and just before I came here I was speaking to a gentleman, a member of her Majesty's Government—one of the present Cabinet—and I told him, as I was coming out of the House, that I was going to dine with some friends of the Atlantic telegraph. His countenance at once brightened up, and he said to me, "I look upon that as the most glorious thing that man ever attempted; there is nothing which so lays hold of my sympathies." (Cheers.) When he said that he spoke only the feelings of every intelligent and moral man in the whole world. (Loud cheers.) When the news reached us that the last cable was laid, did it not make a revolution and a shock? Did not every man feel that a new world and a new time were opened to him? It was, I recollect, just at the time when some great work was being inaugurated at Cherbourg under the auspices of the French Emperor, but it sank into insignificance compared with such glorious news, and everbody felt, as everybody must have felt 400 years ago, when the simple, adventurous sailor of Genoa had opened a new world to the knowledge of mankind. But he only discovered to Europe what I may be permitted to call an unoccupied wilderness; but this project is one to unite 30 millions of people to the 250 millions who inhabit this continent of Europe, and passing from the days of Columbus I know of no event in history comparable in grandeur and sublimity (if we look at its results) with that magnificent enterprise to which Mr. Field has devoted his talents and his life. (Cheers.) I thank you for your kindness in listening to me so far, and I hope that some short time after this great event shall be accomplished we may have the satisfaction of seeing Mr. Field amongst us again to congratulate him on the result to which we look forward with so strong, so intense an interest. (Loud cheers.) The hon. gentleman resumed his seat.

The Hon. Mr. Evarts, of Boston, Massachusetts, also spoke to the same effect upon the political importance of the telegraph. Its commercial advantages and prospects were the subjects of able speeches from the Hon. R. Grimston, Mr. Brassey, and other gentlemen.

LAW INTELLIGENCE.

Newall v. Glass.—This was an action for the infringement of a patent for an apparatus used in laying down submarine electric cables for telegraphic purposes, and after a trial at Westminster, before the Lord Chief Baron, which lasted several days, the jury found a verdict substantially for the plaintiff. Mr. M. Chambers, Q.C., on the part of the defendant, now moved for a new trial, on the ground that the verdict was against the evidence, and also on several other grounds. At the trial the learned judge directed a verdict to be entered for the defendant on some of the issues. The patent was for a mode of stowing on board a vessel an electric cable so as to enable it to be paid out without kinking or getting into knots, and the apparatus consisted simply of a cone composed of spars, round which the cable was coiled. The Lord Chief Baron said it was a patent for the use in a particular way of things which were to be found on board of every vessel. The patentee did not propose to make the cone or the coil, but asked for a royalty or tax from all persons who adopted his particular arrangement. He (the Lord Chief Baron) owned that in his opinion a man could not have by law, a patent for a thing he did not make. The plaintiff really said, "You shall not use your own materials in a particular way for letting out a cable, unless you pay me a royalty;" but that was a new mode of taxing the British public, to which they would be very great enemies. The Court granted a rule *nisi*.

CORRESPONDENCE.

BONELLI'S TELEGRAPH COMPANY.

To the Editor of the Telegraphic Journal.

Sir,—I should be obliged by your finding space in your next issue for the enclosed letter.—I remain, yours truly, Henry Cook.

[Copy.]

Sir,—With reference to the reprint of my Report to the Jurors on Bonelli's instrument you ask me whether my views of the value of that invention have remained unchanged since 1862.

I have now the pleasure in saying that my opinion of the arrangements is now much more favourable. The practical test I went through necessarily has been successfully made, and five wires have replaced the eleven used in the working model exhibited—a substitution which alone doubles the value of the invention. I have also by a calculation ascertained that the required speed can be maintained on land lines of much greater length than I had anticipated; and this calculation is confirmed by experiments which you inform me have been made by the Chevalier Bonelli. You are mistaken in supposing that even in 1862 I thought unfavourably of the invention. It was necessary, in justice to other exhibitors, that I should point out what I considered to be weak or doubtful points; but if you turn to page 47 of the Report, you will find that I mention one main advantage which the plan has over all other automatic arrangements, viz., that it alone dispenses with what I call the second transcription of the message.

To this I will now add, but although other automatic instruments will undoubtedly transmit a larger number of words per minute (of course, in conventional signs) with an equal number of wires, I think Bonelli's system peculiarly trustworthy, and free from liability of error.

6, Duke-street, Adelphi, Yours very truly, Fleeming Jenkin.
April 13, 1864.

To the Editor of the Telegraphic Journal.

Sir,—It is greatly to be hoped that your correspondent "G. R." may be more accurate in his appreciation of the instruments he intends to describe, than he is in the case of those which he has undertaken to abuse. As the alternative to ignorance would be a very painful one, I assume that "G. R." is ignorant, and beg to inform him that Bonelli's instrument requires five, and not nine, wires. That with these five wires it can get through a vastly greater amount of work than any other instrument with an equal number. And, lastly, that the cost of a five wire line is nearly double, and not as "G. R." attests, five times that of a single line.

To expose the absurdity of "G. R's" assumption, that the chances against uninterrupted communication on a complex line, are "not merely as the number of wires, *but* as their combinations," would be to insult the intelligence of your readers.—I am, sir, yours obediently, Henry Cook.

SPEED OF TRANSMISSION.

To the Editor of the Telegraphic Journal.

Sir,—I have read with considerable pleasure the interesting communications which have appeared in your columns on the speed of transmission attained on various instruments. We have had a vast amount of incomprehensible twaddle enforced upon our attention for some time with respect to the number of words which can be transmitted along an insulated wire in a given time. The writers are evidently ignorant of the practical operations of telegraphy, and the nature and construction of the various instruments employed. The laws of transmission are well known, but the action of the current on various instruments must be taken into consideration; for instance, the current does not act in the same manner upon the Hughes and the Morse instruments, and several others which I might mention. I am glad to find that the Bonelli and the Hughes instruments are to have a competing trial. Would it not greatly benefit telegraphy to have every known instrument put on its trial at the same time? J. L. Davis.

BALATA.

To the Editor of the Telegraphic Journal.

Sir,—The advent of a new material well adapted for insulating purposes is a matter of considerable importance to the telegraphic world. The enormous expense of gutta percha and india rubber almost acts as a prohibition to the extension of submarine telegraphy. The new gum, it is said, can be procured in inexhaustible quantities, and at about one-fourth the price of gutta percha and india rubber. At a recent meeting of the French Academy of Science, M. Serres gave a very interesting account of the gum. M. Serres affirms that the material is superior for many purposes to gutta percha, and more especially as an insulating material for telegraphic wires. Sir William Holmes has forwarded samples of the gum to the Society of Arts from Demerara, and states that it can be supplied to any amount. I believe that extensive experiments are being carried on at the present time, to ascertain the properties of the newly-discovered gum, with a view to its extensive application for insulating and other purposes. Having been favoured with some specimens of the material in the state in which it is imported into this country, I have subjected it to a few but stringent electrical tests, and the results are very favourable. The gum is remarkably free from foreign matter, and much resembles in texture well-cleansed gutta percha. Its insulating power is higher than that of virgin or unmasticated rubber, but about 15 per cent. less than that of masticated rubber. In comparison with gutta percha, I find that it insulates nearly 25 per cent. better, and that its inductive capacity is considerably below that of gutta percha. From its appearance, its firmness, and pliability, it appears to me to be exceedingly well suited for insulating telegraphic wires. However, I hope that I shall be able in a short time to furnish you with a fuller account of the investigations upon which I am engaged than I am at present prepared to do. I have myself perfect confidence in both gutta percha and india rubber as insulators for submarine lines; but the introduction of a material possessing all the requisite qualities at one-fourth the price, would be hailed by every one interested in the development of the science of submarine telegraphy.

20th April. I am, yours, &c., Experimentalist.

TELEGRAPHIC NEWS.

Bonelli's Telegraph Company.—We understand that His Royal Highness the Prince of Wales has expressed a desire to witness the operations of Signor Bonelli's ingenious apparatus, and that the instruments are to be exhibited to His Royal Highness at Marlborough House upon His Royal Highness' return to town from Sandringham Hall.

Atlantic Telegraph.—Mr. Cyrus W. Field, after a lengthened visit to England, takes his departure for New York with the next mail. The success which has attended his labours in the advancement of the great undertaking with which his name has so long been identified, is by this time familiar to all our readers; and we sincerely trust that Mr. Field, long before the expiration of the year 1865, will be able to receive the congratulations of his numerous friends on this side of the Atlantic through the submarine cable now in course of manufacture.

The Persian Gulf Telegraph.—Advices have been received from Sir Charles Bright announcing the entire completion of the Persian Gulf cable on the 27th of March. The line was working excellently through its entire whole length. The land-line between the head of the gulf and Bagdad is not yet completed. The above intelligence appeared exclusively in this journal last week.

Electric Telegraphs in New Zealand.—£150,000 has been set apart by the General Assembly from the £3,000,000 loan lately sanctioned for the purposes of telegraphic communication; and £75,000 has been allotted for telegraph works carried out within a period extending to March, 1865. The first portion of the main trunk line is now nearly completed, and messages will shortly be transmitted along that section.

The Indo-European Telegraph.—From the *Bombay Gazette* of the 29th ultimo we learn that "The Persian Gulf telegraph expedition continues to be singularly successful. The work of submerging the second great section of the cable (from Cape Mussendom across the Gulf to Bushire) was completed on the 22nd inst., and the Bombay Government has now the means of direct telegraphic communication with the British residents at Bushire, a matter of no small political importance at this moment. The laying out of the third and last section of the cable (from Bushire to Bussora) has not yet been commenced; but it is reasonable to anticipate that by the time this mail reaches England the whole line will have been finished and placed in proper working order. The sole cause of anxiety is the hostility of the Arab tribes, who have become very troublesome near Mussendom as well as at the head of the Gulf. Her Majesty's ship Vigilant, Commander Hobson, has gone up the Gulf to keep watch over the telegraph stations on the coast."

The Spezzia and Corsica Cable.—The submarine telegraph cable in the Mediterranean between Spezzia and Corsica has just stopped working. A vessel with telegraphic engineers and workmen on board is on the point of starting for the purpose of repairing it. This cable was submerged in 1853, and is the oldest as well as the first deep-sea line of great length laid down. It contains six conductors. At the close of 1863 only four of these wires ceased to work for the first time, and the two others have only stopped working during the last few days. We cannot help remarking the coincidence between the cessation of this cable and the death of him who laid it in 1853—we speak of the late J. W. Brett, the founder, it may be said, of submarine electric telegraphs. As for the cable, it appears easy to repair it. It will still long preserve—at least let it be hoped so—the reputation of being the best and oldest of all the great submarine cables, of which the average duration has not exceeded fifteen months.

Bonelli Telegraph.—The visitors to the Royal Institution, Albemarle-street, had an opportunity afforded them on Friday se'nnight of witnessing the working of the Bonelli telegraph. A large and fashionable company having assembled to hear a lecture by Professor Blackie on gun-cotton, proceeded at its close to the reading-room, where a Bonelli telegraph apparatus was placed at either end of the room, and by means of which messages were transmitted and received with the rapidity of thought, and printed at length in Roman characters. Mr. Cook, the managing director of the Bonelli Telegraph Company, and who has been indefatigable in his endeavours to promote the extension of the system, attended on the occasion, and explained the working of the apparatus to a much interested audience, and supplied them with slips with the messages received. Mr. Cook stated that one of the Bonelli instruments would do the work of thirty-two Morse and forty-eight needle instruments, and that an experiment had been made between Manchester and Liverpool for the purpose of testing the speed with which messages could be transmitted, and that 897 messages of twenty words each had been forwarded in forty minutes and nine seconds. Mr. Cook also stated that the Chevallier Bonelli had obtained permission to establish a telegraph mail between Milan, Turin, Genoa, Florence, and Trieste.

The following communication appeared in the daily journals of the 20th ult.:—"To the Editor. Sir,—A challenge having been given by the United Kingdom, and accepted by the Bonelli Telegraph Company, for a competitive trial of the relative merits of the systems of Hughes and Bonelli, it has been thought advisable, as a proof of the *bona-fides* of the pretensions put forth by Bonelli's Company, not to close the lists as had been intended, on the 30th instant, but to defer it to the 7th of May. The trial, so far as the Bonelli Company can influence the matter, shall be immediate, and certainly will not be deferred beyond the 30th instant. The refusal or neglect of either company to submit to the proposed test by this date must be considered as an acknowledgment of defeat. I am, sir, your obedient servant, J. Gutteres, Sec. (pro tem.)"

The Application of Electric Power to Railway Breaks.—It is some time since we took occasion to notice a pamphlet, in which was embodied an account of a most ingenious application of the voltaic battery to the mechanical arrangement necessary for arresting the progress of a train of railway carriages. The invention was that of M. Achard, a French engineer of considerable eminence, and had received at the time of our previous notice the approval of M. Duchoiz, the inspector of the railways between Paris and the Mediterranean. The apparatus has been at work for some months on the Paris and Strasbourg line, and we hear that its practical usefulness has been so well proved that fresh carriages are being fitted up with the machinery, which may be thus described (allowing for always recurring difficulty of making descriptions of machinery intelligible without

the help of models) to convey a tolerably clear idea. The break is worked by electricity in the following way :—The voltaic battery is placed in the break-van, and by means of insulated wires the electricity is conveyed from one end of the train to the other, communicating with the double magnetic coil placed near the axle of the break-van. At the poles of these two coils are two iron sliding-plates, bolted together at the top and at the bottom, holding a click, which, when the breaks are being put on, drops down and works into a ratchet-wheel until the breaks bring the wheels of the train to a skid. When the electric current runs through the train the coils hold the sliding-plates and click up, and the apparatus remains out of gear; but as soon as the current is intercepted a spring brings them down to act upon the ratchet. An eccentric wheel fixed on the axle of the van works the click up and down, and at each revolution moves the ratchet-wheel a certain distance. To the shaft of this wheel is fixed a double clutch box, and between a loose drum with a clutch at each end, so that it is no sooner released from one side than it falls into the clutch-box on the other. To this drum is attached a chain acting upon the lever of the ordinary blocks, and pressing them lightly against the tires of the wheels. As the rachet-wheel turns the drum turns with it, and lightens the chain until the train stops, and to release the break the drum is shifted by means of a lever from one clutch-box to the other, the play between the two being sufficient for that purpose. As soon as the break is released and the current of electricity reversed, the first turn of the wheel raises the working click above the ratchet-wheel, and the coils hold it there by means of the sliding-plates, so that it does not come into operation until the electricity is again disconnected. One great advantage of this is, that in the event of the couplings of a train breaking in going up an incline, or part of a train running off the metals going down an incline, or in case of fire, the breaks would act automatically and stop the train. We have had the satisfaction of examining a working model of the invention; and our own opinion is very favourable to the efficiency of the principle and of the power employed; and we understand that the locomotive superintendent of two of our London lines have received instructions to go to Paris in order to see the break in actual operation. Of course great interest attaches to the report of these gentlemen. In the meantime we may say that the model which we have inspected was of remarkably ingenious construction, and did not suggest to our mind the possibility of any mechanical obstacle occurring to the efficient carrying out of the invention.

MISCELLANEA.

Coating Iron with Aluminium.—Mr. William Clark has invented a peculiar process for covering the surface of iron with a layer of the latter metal. The surface of the iron is first cleansed; a mixture is then made of porcelain-clay, feldspar, and white-lead, properly ground and incorporated; then about ten parts of this combination are added to about five pounds of calcined and powdered alum-clay. This last mixture having been made into a thin paste, and poured over the surface of the metal, the latter is dried and placed in a reverbratory furnace until it presents a glazed appearance. When the iron is removed it will be found to have received a tough adhesive, and elastic coating, which is so closely attached to the metal that, when this is bent, even at right angles, no symptoms of cracking appear. This coating is also unacted on by acids and alkalis. It is supposed that during the baking process the aluminium is separated from its oxide, and forms a thin metallic stratum, intermediate between the iron and the glazed surface.

Novel Electric Fuse for Blasting Purposes.—This, which is a French invention, differs from all those previously employed, and appears to be highly spoken off. It admits of being rapidly manufactured, whilst the chances of fracture are reduced to the smallest number. It consists of an insulated wire, to which the usual fuse-tube is attached, and has a second wire, uninsulated, coiled round it, so that its extremity is about a centimetre from that of the first. Finally, there is a bag attached to its extremity, containing the explosive compound. When an induced current is passed through the wires, the spark traverses the powder contained in the pouch: it melts the thin thread employed to complete the circuit, and passes through both wires. By adopting this process a great number of blasts can be exploded simultaneously, as there may be branch wires from the main stem to various other localities.

The Real Nature of the "Electric Fly."—The piece of apparatus which bears this name has had its history well worked out by Mr. Charles Tomlinson, who has compiled for the benefit of natural philosophers, an account of the various theories held regarding the character of this instrument. Mr. Tomlinson has been led, from his numerous experiments, to conclude that the theory requires a different expression for an aerial as compared with a liquid di-electric. It seems to have a different action in airs of different densities, and also according as it is wholly or partially enclosed. Its action, when the points are covered, is also distinct, and is equally peculiar in the presence of flame. Hence it may be said, that "there is no one expression that fairly represents the electric fly. It modifies its behaviour according to circumstances; and, like a good subject, has no law of its own, but conforms to the laws of the community of which it is a member."—*Philosophical Magazine.*

The South of England Literary and Philosophical Society.—This society has been formed to meet the generally expressed want of an association which should serve to bring together occasionally and to promote the co-operation of those who in the town of Southampton and the surrounding neighbourhood are occupied in the pursuit, or interested in the progress of literature and science. Societies of a similar nature exist in all the large towns of the midland and northern counties, and there appears no reason why the important and populous area of which Southampton is the centre, should be unrepresented in the great body of educational institutions which these societies form. Not only is the district which the operations of such a society would embrace, rich both in natural history productions and in objects of antiquarian interest, but Southampton itself in its scientific institutions, such as the Royal Military Hospital and Army Medical School, the Ordnance Map Office, and the Hartley Institution, possesses the materials for a scientific organization at least equal to that of any town of the same size in the kingdom. The objects which the society has in view are the cultivation of literature and science, including archæology, by periodical meetings for the reading of papers, exhibition of objects of interest, and discussions thereon; and by excursions, *conversazioni*, and other similar means. It is pleasing to us to note that Mr. W. H. Preece, C.E., Superintendent of Telegraphs in the South Western districts of England, has contributed largely to the success of this society by his literary labours and scientific researches.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.
Good re-boiled	1/6 to 1/8 „

India Rubber.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/5 „

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

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100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	98 to 101	—
100	Submarine Telegraph, scrip. .	all	48 to 58	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

L. D.—Your communication will appear next week.

Amicus.—Mr. R. S. Culley's "Hand-book of Telegraphy" can be obtained of Messrs. Longman, Green, & Co., Paternoster-row, London.

A Subscriber is thanked for his suggestions.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

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ON THE APPLICATION OF ELECTRICITY TO DOMESTIC PURPOSES.

By WILLIAM HENRY PREECE, Assoc. Inst. C.E.

(*Continued from page* 195.)

5. *The Indicating Tablets.*—Now the peculiarity of the French system is this: they do not use one bell for every room, as we do, distinguished for each particular chamber by its sound or note, but they allow one bell to answer for any number of rooms, and the particular room that rings is indicated by a number displayed upon a tablet. An hotel is ranged in floors. There is one bell to each floor, and an indicating tablet with the number of every room upon that particular floor designated upon it. A floor may be divided into galleries, and each gallery have its separating indicating tablet. The particular range of rooms under the charge of one set of servants has its particular bell and tablet, which are fixed where the bell is easily heard and the tablet easily regulated. A restaurant is fitted up in the same way; but for an ordinary private house it is sufficient to have one bell and an indicating tablet fixed in the kitchen or servants' hall, with each room enumerated upon it. I will describe an indicating tablet for a four-roomed house.

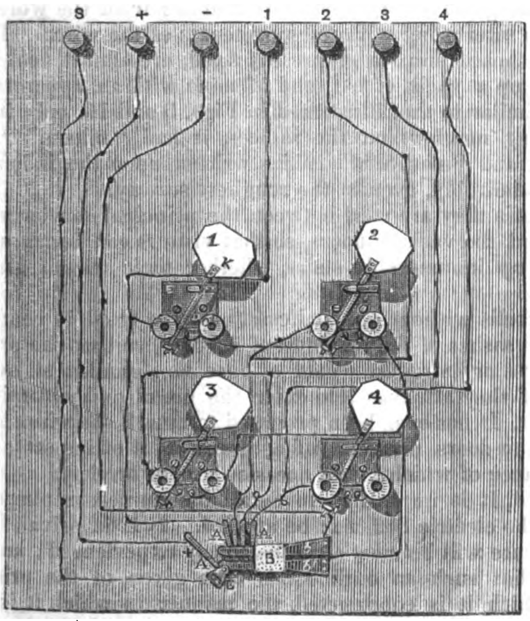


FIG. 9.

The buttons 1, 2, 3, 4 (Fig. 9) are placed in separate rooms but they are here brought close together the better to illustrate the description. The indicating tablet and bell are placed in the kitchen within easy reach of the servant. The rooms are numbered 1, 2, 3, and 4, and are so indicated on the tablet, but they can as well be designated "Dining-room," "Drawing-room," "Bed-room," and "Dressing-room," or otherwise. The tablet consists of a blackened glass frame, with four windows or openings in it, through which are shown either a white face or the numbers or names of the rooms as depicted in the above figure. The interior construction of the indicating tablet is shown in Fig. 10. (See next page.) It contains four indices, each of which is actuated by a distinct electro-magnet, shown for index No. 1 by *c* and *c'*. These indices are formed of thin cardboard or plates of mica, upon which the numbers or names of the different rooms are inscribed. They are fixed upon a magnetic needle, which moves freely upon a centre, between the two poles of the electro-magnet, and which is furnished at its lower extremity with an adjusting weight to maintain the needle balanced in any position. When a current passes through the electro-magnet from left to right the needle is thrown over in the same direction, the number of the index appearing in front of the opening of the case, and remaining there, retained by the magnetic effect of the needle upon the iron core of the electro-magnet, even after the current has ceased to flow. When, however, a current is sent in the reverse direction, the needle is restored to its original position, the number leaves the opening, the white face returns, and it remains in the position shown in Fig. 10.

The course of the current is easily traced. Take the wire No. 1 in connection with the button No. 1 (Fig. 9). It arrives at the terminal 1 (Fig. 10), and thence descends to the electro-magnet, *c*, through which it passes, and proceeds further to the spring, *b'*, which is in contact with the piece, E, and from thence it goes through the terminal, S, to the bell. Another wire is attached to this before it enters the electro-magnet, *c*, that descends to the little spring, A, which remains insulated in the normal position of the instrument. The other wires can be similarly traced, each passing through their separate electro-magnets, to the spring, *b*, and thence to the bell, and, having separate branches to distinct insulated springs, A A. The positive pole of the battery is attached to the second terminal (+), from whence it proceeds to the plate, A', which is also insulated from E and *b*. The negative pole is connected to the terminal (—), and proceeds to the spring, *b*, which is insulated and fixed like *b'* under the button, B. The battery is attached to this apparatus to restore the indices to their normal position.

The action of the instrument will now be seen. Button No. 1 (Fig. 9) is pressed—the current flows—it enters the tablet (Fig. 10) by terminal 1—it passes through the electro-magnet, *c c'*, throwing the needle over to the right, and displaying its number or name in the opening of the front case (Fig. 9). It then proceeds to spring, *b'*, through piece, E, and terminal, S, to the bell, which it rings as long as the button is held down. The finger is removed from the button, the bell ceases to ring, but the indicating number remains displayed upon the face of the tablet. The servant has heard the bell, observes the number or name of the room, and before proceeding to reply to the summons, presses the button, B, which brings *b'* into contact with A, and therefore the positive pole of the battery, and *b*, which is the negative pole of the battery, into contact with A, which is in connection of the electro-magnet, *c c*. A current is therefore sent through the electro-magnet in the reverse direction to the first current, the needle is thrown over to the other side, the indicating number is removed, and the instrument restored to its normal state. The same effect occurs with each index, and they are all actuated at the same time by the pressure of the button, B, in this particular instrument, but an alteration is frequently made which enables each number to be separately restored to its normal position. It will thus be seen that in whatever room the button is touched the bell is rung, and the number of the room is displayed upon the tablet.

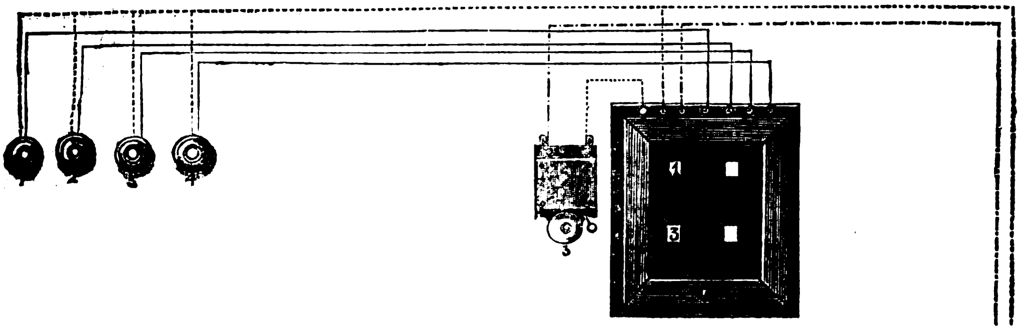


Fig. 10.

Two, three, or any number of rooms may ring at the same time. It matters not; the number is displayed upon the tablet. There is no confusion in the sound of the bell. The particular note of any particular bell is not required to be remembered; the servant has but to look at the tablet and she sees at once from whence the summons came. The tablet in Fig. 9 shows that rooms 1 and 3 have rung. These numbers will remain displayed until the call has been answered. The button at the bottom of the tablet is pressed, and the instrument is ready for another call.

It is easy to understand from the above description how the numbers of indices upon the tablet can be increased, and how one bell can be made to answer for any number of rooms. I have seen tablets with 50 numbers indicated upon them.

It can also be readily perceived how a series of rooms can be indicated on different floors or in different positions. Thus the sitting-rooms can all be shown in the butler's pantry, the bed-rooms in the kitchen. The bed-rooms can also ring, and indicate on the landing of the servants' sleeping apartments, so that attention can be gained at night. Indeed, it is scarcely necessary to relate the various modifications and arrangements that can be made. Bells can be fixed anywhere, and be rung from any spot.

I have now detailed the construction of the battery, the generation of the current, the nature of the wires destined to convey the current, the buttons that complete the circuit, and set the current in action, the bells that are actuated by the current, and the tablets that indicate the room from whence the current proceeds. The system that I have described is that called Prud'homme's, and it was partially exhibited at the International Exhibition, 1862; but considerable alterations have been effected since that period, and it is probable that we may yet see further improvements. English visitors to the French metropolis may have seen it in action at that splendid hotel, the "Louvre;" but if they have also visited that great *caravanserai*, the "Grand Hotel," they will have perceived a different system in use. It is that of M. Breguet, one of the cleverest and most ingenious of French mechanics and electricians. It is in every respect similar in principle, as regards buttons, bells, and tablets, to the system I have described; but it differs considerably in electrical and mechanical detail. The numbers are not shown upon an index moved up into position, but they are fixed. An electro-magnet releases a pointer, or marker, which falls and remains exposed over the number until replaced by the hand. Every number, or room, has its separate pointer. The "Grand Hotel" is fitted up so that the bells ring continuously; a plan which may have its advantages, but which certainly has its annoyances to those who are unfortunately located near the *bureau du service*. Breguet's system is, perhaps, the more mechanical, but Prud'homme's is the cheapest. As its economy may lead to its introduction in preference to the other, I have chosen to describe Prud'homme's rather than illustrate Breguet's system. The trembling bells have long been known in England, but they have never been extensively employed. The principal objection to their use has been the supposed trouble in maintaining the battery in order; but this trouble is pure supposition, and the battery will be found to require *infinitely* less trouble than the gas, water, or any other convenience in a modern establishment.

It now only remains to point out some of the purposes to which these bells and indicating tablets are applied.

They can be used not only to indicate rooms, but to designate men. Thus a tablet and bell can be fixed between the merchant's counting-house and his warehouse; between the manager's room, the lawyer's sanctum, or the banker's den, and the clerk's office; between the manufacturer's retreat and his workshop, with the names of clerks, foremen, or workmen inscribed upon the indices in place of the numbers. Again, they can be fixed between the private house and the stable, with the names of servants, horses, or carriages indicated upon the tablet.

In large establishments, such as Government Offices, Banks, Railway General Offices, they can be fixed between the principal offices and the porter's room, to enquire if the chief officers are in or out, engaged or disengaged.

They can be applied with great advantage on board vessels for sailors; and those who have had to do with ships and yachts know the great inconvenience that arises from the working of the ship interfering with the movements of the wires. Indeed, bells on board ship, as at present fixed, are almost nonentities. I fitted up a yacht of a friend of mine with an apparatus precisely similar to that illustrated in Figs. 9 and 10, only in place of having numbers on the indices, it had "saloon," "after," "port," and "starboard" cabins written upon the indices. It works admirably, even in the roughest seaway.

In Paris they are used between the principal concierge of an hotel and the various floors, so that visitors can learn, without puffing up innumerable stairs, whether their friends are in or out.

The bells without the indicators can be fixed in connection with the sashes of the windows of a house, so that the presence of thieves or intruders would at once be signalled all over the house, if they attempted to enter the premises by opening the windows. It has even been proposed to attach the wires leading to them to doors, drawers, safes, or any point of importance, the disturbance of which might occasion loss or anxiety.

Indeed, it is impossible to detail the numerous purposes to which the electric bell may be applied. It is in private houses that its use will be most advantageously experienced; and it is hoped that such an outline has been given of the principles upon which it is constructed, the manner in which it is fixed, and the method by which it is worked, as to enable the novice to comprehend its action, the householder to gain sufficient confidence in its working to employ it in his residence, the merchant to adopt it in his counting-house, and the sailor to fit it on board his ship.

OCEAN TELEGRAPHS.

OUR Paris correspondent lately gave an account of a plan for laying an electric telegraph cable between Europe and America. Notwithstanding the far greater distance, India will soon be fewer hours from England than America is days, so far as telegraph communication is concerned. There are two principal factors upon which the solution of the problem of oceanic telegraphy depend. One of these is the nature of the cable which is to carry the electric wire; the other is the surface over which this cable is to be laid. Naturalists tell us that ten miles in perpendicular depth of the earth's crust are within the sphere of scientific observation. The loftiest mountains are about five miles high; the profoundest seas that we have fathomed are about that depth. Sea maps show us the Atlantic Alps which, a few hundred miles to the west of Ireland, present a steep decline of some thousand feet. Three-fourths of the surface of this planet are covered with water. Our world, the dry land, is but a mere fraction of it. Yet on this one quarter on which we live there are mountains—like the Himalayas—which rear their crests far above the snow line into the region of eternal winter, to a vertical distance of more than five miles above the general surface. The peak of Dwaligiri is near twenty-nine thousand feet above the level of the sea. It is probable that in the unexplored depths of the great Pacific the ships that float on its surface are much more than five miles' distance from the land at the bottom. Curious reflection for the voyager that there is only a plank between him and perhaps ten or twenty miles of perpendicular brine. Compared with this vast ocean, the broad Atlantic, deep as it is, is probably a mere shallow. But whatever depth we take, whether five miles or one, or any fraction of a mile, every degree between that and nothing must exist, measuring from the deepest part to low water mark on either shore, where, at ebb tide, the ripple chafes against the sand and whitens it with its foam. Then, again, the existence of islands, which are only the tops of mountains, of greater or less magnitude, tell of the inequalities of surface which prevail far from the shores of the continents. Sandbanks and shallows teach the same lesson. In a word, we cannot doubt that the configuration of the earth's crust beneath the sea is pretty much what it is as we know it above the water line. Not that it is so abruptly rugged and angular. There is reason to believe that the action of the waters has rounded and smoothed off asperities Stone rocks here and there may present a sharply defined outline, but the inequalities of the general surface are probably very gradual.

But there is another cause of the presumed absence of sharp points on the submerged surface of our globe. There must be a much vaster amount of animal life in the seas which cover three quarters of this earth than there is on the dry land; and whatever lives in the waters lies down to die on the bed of the ocean. The substance brought up by soundings in deep seas invariably consists of what was once part of living organisms, swimming about, hunting other creatures for prey, and being in turn hunted itself. A shoal of herrings is several miles long, and as many broad; perhaps in deep waters it is also miles in perpendicular extent. A whale is the largest animal of which we have any authentic knowledge, and if krakens have existed, or exist now, a single specimen must contain as much animal matter as a large drove of bullocks. The remains of the inhabitants of the sea all serve to form so much padding to line the bottom of it as with a soft cushion. It is not likely, therefore, that an electric telegraph cable laid across the Atlantic would meet with perpendicular gaps and chasms of great width, from brink to brink of which it could be suspended for miles like the over-house telegraph across streets, and thus break itself by its own weight, if it were not made unreasonably ponderous. But if there were such chasms, that would be an additional reason for having it made as light as possible. To unite the maximum of strength with the minimum of weight, sufficient to make it sink at all, is the great desideratum. The greatest danger of the cable parting is in paying it out from the ship when it is being laid down. This is another reason why it should be made as light as possible—of course with a specific gravity adequate to sink it.

Now, in the plan alluded to above, it is maintained that a copper wire conductor, covered with a Manilla hemp insulator, is the lightest cable that can be made, and is yet quite heavy enough to sink, and strong enough to hold together and bear any strain to which it will probably be subjected. The waters of the sea, at a comparatively very short distance below the surface, are perfectly still, even in the most violent tempest. It appears that in our Channel—a mere ditch compared with deep seas—the telegraphic cables at the bottom are never disturbed by tides and currents, much less by agitation produced by storms on the surface, but only by trawls and anchors. Of course there may be marine monsters at the bottom of the great ocean of which we know nothing, and the wider the extent traversed by the cable the greater the chance of disturbance from huge living creatures. If the cable, in any part of its course, were to pass from one submarine precipice to another, like the over-house telegraphs across the Thames, the chances of great fish coming into contact with it and snapping it asunder would be increased. Still no strength that we could give it by means of iron wire could enable it to stand this shock any better than a simple coating of hemp. The weight of the cable intended to be laid across the Atlantic is described as so great that there is no ship in the world, except the Great Eastern, that will carry it. Its cost, too, is represented as being quite as heavy as the specific gravity. The two thousand three hundred and odd miles of it, at £300 a mile, the estimated cost, will amount to near three quarters of a million sterling. If the statement before us be accurate, there have been several failures of much shorter cables than this, but made on the same principle, through their great weight rendering them unwieldy and unmanageable. It seems that the Falmouth and Gibraltar cable cost £300 per mile, and when made it was declared to be useless. It was impossible to lay it down, its weight being so great as to break of itself. So, after lying idle for a couple of years, it was laid down in shallow water along the Barbary coast, between Malta and Alexandria. The Atlantic, the Red Sea, and the Algiers cables are all stated to have destroyed themselves through their too great weight. If these data be sound and the inference deduced from them valid, it is not difficult to foresee what fate awaits the Atlantic cable, which the Great Eastern is to lay down in 1865. This is a subject well worth the attention of the scientific world.—*Morning Post.*

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 199.)

C. F. Varley, M. (United Kingdom, 2,981), exhibited an arrangement by which the position of a fault of insulation, either on a land-line or in a submarine cable, can be determined with very great accuracy, whenever the fault can be included in a complete circuit starting from, and returning to, the testing station, and everywhere insulated except at the fault. On land-lines this condition is almost always attainable by joining two of the line wires at a station beyond the fault. In submarine cables the condition can always be fulfilled before the cable is laid, but after submergence the cable must contain two insulated conductors to allow the application of the test. The method adopted by Mr. Varley is especially excellent, inasmuch as the uncertain resistance of the fault does not vitiate the test, which will give one constant result whether this resistance be great or small, constant or continually varying, during the experiment.

A differential galvanometer and a set of resistance coils are the only instruments required. The resistance of the whole circuit is first determined by connecting the two poles of a battery to the two ends of the line circuit through one coil of the differential galvanometer, while the two ends of the resistance coils are also connected with the two poles of the same battery through the other coil of the galvanometer. When the galvanometer needle has been brought to zero by adjusting the resistance coils, the resistance of these coils will clearly be equal to that of the complete line circuit, quite independently of the fault, since the earth forms no part of either of the balanced circuits. Let us call this resistance r.

After determining this resistance the connections are altered, so that one pole of the battery is put to earth, and the other pole connected with the one pair of ends of the two differential coils; the other ends of these coils are then connected with the two ends of the line circuit respectively, and the resistance coils introduced into the line circuit between the fault and that differential coil which is nearest to it. Let the resistances of the two sections of the line between the testing station and the fault be called x and y respectively, and let y be the smaller of the two. Then, if the resistance of the coils in their new position be adjusted until the galvanometer needle be again brought to zero, and this new resistance be called R, we have the following relation experimentally determined:—

$$x = y + R.$$

The resistance of the fault is included equally in the two balanced circuits; and, therefore, whether great or small, constant or variable, does not interfere with the above relation. Moreover, by the first test, $x + y = r$, and eliminating x from the two equations, we have

$$y = \tfrac{1}{2}(r - R).$$

If r and R be expressed in miles of the conducting wire, y will also be expressed in miles, and will tell the observer directly the distance of the fault. It should be observed that, since r given by the first test is equal to twice the resistance of the line between the stations, and that R, given by the second test, is equal to twice the resistance of the line between the far station and the fault, $\frac{R}{r}$ is, therefore, equal to the fraction which the distance between the far station and the fault is of the whole distance between the stations.

In Mr. Varley's apparatus the change of connections required for the double test is made very simple by the depression of a key, so that the whole operation is mechanical, and the test can be, and actually is, made by uneducated workmen.

After this apparatus had been exhibited to the jury, the writer believes that it was removed from the building.

2. *Resistance Coils.*

In order that different observers should be able to compare the results of their separate observations, it is clearly necessary that they should use the same unit of resistance, or should at least know accurately the relative value of their several units. No two sets of resistance coils exhibited are alike, and it is, therefore, thought useful to give the annexed table of the relative values of the several

Table F.—Relative Values of various Units of Electrical Resistance.

Description.	Name.	Absolute $\frac{\text{foot}}{\text{seconds}} \times 10^7$	Thomson's unit.	Jacobi.	Weber's absolute $\frac{\text{metre}}{\text{seconds}} \times 10^7$	Siemens (Berlin)	Siemens (London)	Digney.	Bréguet	Swiss.	Matthiessen.	Varley.	German Miles.	Observations.
*Absolute $\frac{\text{foot}}{\text{seconds}} \times 10^7$ electro-magnetic units (new determination)	Absolute $\frac{\text{foot}}{\text{seconds}} \times 10^7$	1·000	0·8750	0 4401	0·3048	0·2912	0·2878	0·03028	0·02870	0·02687	00·2062	0·01094	0·004878	Calculated from Weber's new determination of the absolute $\frac{\text{metre}}{\text{second}}$ *vide* fourth column; $1 \frac{\text{metre}}{\text{second}} = 3{\cdot}281 \frac{\text{foot}}{\text{seconds}}$.
Absolute $\frac{\text{foot}}{\text{seconds}} \times 10^7$ electro-magnetic units (old determination)	Thomson's unit.	1·143	1·000	0·5029	0·3483	0·3328	0·3289	0·03455	0·03279	0·03071	0·02357	0·01251	0·005574	From an old determination by Weber; should have agreed with first column.
Twenty-five feet of a certain copper wire, weighing 345 grains	Jacobi.	2·271	1 988	1·000	0·6925	0·6618	0·6540	0·06869	0·06520	0·06106	0·04686	0·02486	9·01108	No measurement made—ratio between Siemens (Berlin) and Jacobi, taken from "Weber's Galvanometrie."
Absolute $\frac{\text{metre}}{\text{seconds}} \times 10^7$ electro-magnetic units determined by Weber (1862). . . .	Weber's absolute $\frac{\text{metre}}{\text{seconds}} \times 10^7$	3·281	2·871	1·444	1·000	0·9556	0·9448	0·09919	0·09416	0·08817	0·06767	0·03591	0·01655	Measurement taken from a determination in 1862 of a standard sent by Prof. Thomson; does not agree with Weber's own measurement of Siemens' units; by Weber 1 Siemens' unit $= 1{\cdot}025 \times 10^7$ meter seconds.
One metre of pure mercury one square millimetre section at 0° centigrade . .	Siemens (Berlin).	3·438	3 004	1·511	1·046	1·000	0·9881	0·1038	0·09852	0·09227	0·07081	0·03757	0·01675	Measurement taken from coils exhibited by Messrs. Siemens & Halske (well adjusted).
Ditto ditto ditto	Siemens (London).	3·475	3·040	1·529	1·059	1·012	1·000	0·1050	0·09970	0·09337	0·07166	0·03802	0·01695	Measurement taken from coils exhibited by Messrs. Siemens, Halske, & Co. (well adjusted).
One kilometre of iron four millimetres in diameter (temperature not known) . .	Digney.	33·08	28·94	14·56	10·08	9·634	9·520	1·000	0·9491	0·8889	0·6822	0·3620	0·1613	From coils exhibited (pretty well adjusted).
Ditto ditto ditto	Bréguet.	34·85	30·50	15 34	10·62	10·15	10·18	1·054	1·000	0·9365	0·7187	0·3814	0·1700	From coils exhibited (indifferently adjusted).
Ditto ditto ditto	Swiss.	37·21	32·56	16 38	11·34	10·84	10·71	1·125	1·068	1·000	0·7675	0·4072	0·1815	From coils exhibited (badly adjusted).
One English standard mile of pure annealed copper wire, $\frac{1}{16}$ in. diameter at 15·5° C.	Matthiessen.	48·49	42 43	21·34	14·78	14·12	13·95	1·66	1·391	1·303	1·000	0·5306	0·2365	From a coil lent by Dr. Matthiessen, of German silver wire.
One English standard mile of one special copper wire $\frac{1}{16}$ in. diameter	Varley.	91·38	79·96	40·21	27·85	26·61	26·30	2·763	2·622	2·456	1·885	1·000	0·4457	From coils lent by Mr. Varley (well adjusted).
One German mile = 8,238 yards of iron wire $\frac{1}{6}$ in. diameter (temperature not known)†	German mile.	205·0	179·4	90·22	62·48	59·71	59·00	6·198	5·882	5·509	4·228	2·243	1·000	From coils exhibited by Messrs. Siemens, Halske, & Co.†

* *Note, June*, 1863.—From unpublished experiments made by the Committee on Electrical Standards of Resistance appointed by the British Association, it appears that the true value of the absolute unit lies between the two values.

† Messrs. Siemens do not now manufacture coils with this unit, which has been abandoned by them in favour of the mercury unit given above.

N.B.—The statute mile of No. 8 iron wire frequently referred to in the course of the report was equal to 0·48 of Mr. Varley's units = 1·33 Digney's kilometres of iron wire 4 millimetres diameter.

resistance units exhibited, and also of some others known to have been extensively used. The comparisons were made by the writer with Messrs. Siemens' instruments expressly for this report. It is hoped that before long some common standard will be universally adopted.

The unit of the resistance coils placed second in the table, and shown by J. White, M., Glasgow (United Kingdom, 3,012), was chosen by Professor W. Thomson, and was intended to approximate to a decimal multiple (10^7) of Gauss' and Weber's absolute units based on feet and seconds, irrespective of the special qualities of any particular material. The advantages of the absolute unit have been briefly alluded to in the introduction. Owing to some error (probably in an old determination by Weber), Mr. White's coils, although extremely well adjusted one with another, are far from presenting the desired approximation, if Professor Weber's latest determination of the $\frac{\text{metre}}{\text{seconds}}$ standing forth in the table may be relied on. Had the agreement between Professor Weber's and Mr. White's coils been complete, Weber's unit given in the above table would have been equal to 3·281 White's units (the ratio of the foot to the metre), instead of 2·871. The absolute $\frac{\text{foot}}{\text{second}}$ multiplied by 10^7 calculated from Weber's last determination is given first in the table. The unit marked on the coils shown by Mr. White is 10^8 times the absolute $\frac{\text{foot}}{\text{second}}$, but to avoid confusion the value in the table is given at 10^7, otherwise the $\frac{\text{foot}}{\text{second}}$ would have appeared larger than the $\frac{\text{metre}}{\text{second}}$. The multiple 10^7 of the $\frac{\text{metre}}{\text{second}}$ (given fourth in the table) was chosen as that recommended by the committee on electrical standards of resistance appointed by the British Association for the Advancement of Science.

The relative value of Weber's $\frac{\text{metre}}{\text{second}}$, as compared with Siemens' and Thomson's units, was obtained by the direct measurement of a coil sent by Professor Thomson to Professor Weber, who determined its resistance in absolute measure. The results in the table do not agree within 2 per cent. with the value published by Weber of Siemens' unit. All these discrepancies show the necessity of much greater accuracy than has hitherto been arrived at in measurements of this kind.

The various copies of Jacobi's unit (not exhibited) agree very badly; the values in the table (third column) are taken from the value of Jacobi's unit, published by Dr. W. Siemens, as compared with his own unit. Professor Jacobi's unit is the resistance of a certain copper wire twenty-five feet long, weighing 385 grains (temperature unknown).

Siemens & Halske, Berlin, M. (Prussia, 1,413), exhibit coils based on an unit expressing the resistance of a metre of mercury of one millimetre section at the temperature of melting ice. Each set of coils exhibited by the London and Berlin firms is adjusted with an accuracy of one per thousand, but those exhibited by the two firms differ from one another by more than 1 per cent. Messrs. Siemens suggest that this difference may be due to an alteration in the German silver wire of which the coils are made; but it seems at least as likely that the mercury standard has not been maintained or reproduced with exactitude. This opinion is somewhat supported by the fact that Mr. White's coils, although they have been in constant use for three years, are still adjusted with about the same degree of accuracy as Messrs. Siemens' (except one coil in which an error of about 1 per cent. occurs). If, therefore, the resistance of these coils, which are also made of German silver, has changed, the resistance of every coil (but one) must have changed in exactly the same proportion—a most unlikely result. On the other hand, Messrs. Siemens inform the writer that the two coils now exhibited by the two firms were really made by the Berlin firms at about the same time. They suggest that, when compared by the writer, they may not have been at the same temperature; but precautions were taken to prevent mistakes from this cause, and a difference of temperature of about 45° Fahrenheit would be required to account for the difference of resistance observed.

MM. Digney's, M., Bréguet's, and the Swiss resistance coils are all intended to represent the resistance of a thousand metres of iron wire four millimetres in diameter, such as is used for telegraphic lines abroad. The three sets of coils differ widely from one another. Messrs. Digney's coils are, however, adjusted, one with another, with no greater error than 0·5 per cent. The coils by the two other makers were very indifferently adjusted, and the values given in the table are only the means of widely discrepant results.

Dr. A. Matthiessen has adjusted a coil (not exhibited) expressing the resistance of a standard mile of chemically pure annealed copper wire one-sixteenth of an inch in diameter, at the temperature of 15·5° centigrade. This resistance is very different from that of a mile of any commercial copper, and the various commercial coppers differ too widely from each other to allow any approximate ratio to be named between them and pure copper. It may be said, however, that the specific resistance of copper selected for telegraphic cables is generally about 20 per cent. higher than that of pure copper. Dr. Matthiessen does not propose this coil as an unit, but the writer thought that its value would be found useful.

Mr. C. F. Varley's unit is the resistance of one particular piece of copper wire one-sixteenth of an inch in diameter and one mile long. The values in the table were obtained from measurements of coils exhibited by Mr. Varley.

A second unit used by Messrs. Siemens & Halske on German railways was intended to express the resistance of a German mile (4·68 English miles or 8,238 yards) of iron wire one-sixth of an inch in diameter (No. 8 B. W. G.); this unit is no longer used by the firm.

A note at the foot of the table gives the value of the statute mile of No. 8 iron wire, occasionally referred to in this report as a rude standard of comparison, conveying a practical idea to those not conversant with the conception of an unit of electrical resistance.

(To be continued.)

THE PERSIAN GULF TELEGRAPH.

To the Editor of The Times.

Sir,—I observe a paragraph in your impression of to-day, to the effect that Sir Charles Bright has advised you of the completion of the Persian Gulf Telegraph. I have before observed Sir Charles Bright's name prominently mentioned in connection with this great undertaking. Far be it from me to attempt to diminish in any way the great service rendered by Sir Charles Bright in laying this most important telegraph. However, I do not think it just, nor do I think that Sir Charles Bright would wish that his should be the only name brought so prominently before the public in this matter. The gentleman who has had the whole management and entire superintendence of this most important work from the beginning, and under whom Sir Charles Bright is at this moment so ably acting, is Lieut.-Col. Patrick Stewart, R.E. The *Times* has often before done ample justice to the merits of Col. Stewart; but there are many persons who have seen these later paragraphs to which I especially refer, who may not have seen your former account of Col. Stewart's services in connection with the Persian Gulf Telegraph. Only last week the remark was made to me, "Sir Charles Bright seems to have the chief superintendence of this telegraph, as the telegrams come from him." To remove that erroneous impression is my reason to trouble you with this letter.

Palmam qui Meruit Ferat.

We reprint the above letter,—at the same time we cannot help thinking but that Col. Stewart may well exclaim, "Save me from my friends!" As we have published several communications received from the East respecting the labours of Col. Stewart and those connected with him in the great undertaking, we believe that our readers will find that in those reports Col. Stewart's name stands the most prominent. The information conveyed in the paragraph which appeared in the *Times* on 22nd ult., appeared in this Journal on the 16th ult., just six days in advance of the *Times*. Our information was not derived from Sir Charles Bright, but from a telegram said to have been received from Col. Stewart at the India Office. The success which has crowned the labours of Col. Stewart in the laying of the Persian Gulf Telegraph redounds greatly to his honour; and we are sure that no one will be more ready to recognise the valuable services rendered by Sir Charles Bright and his experienced staff than Col. Stewart himself.

These attempts to engender professional jealousy are to be deprecated, and the writer in the *Times*, had he been better acquainted with the history of the manufacture, testing, shipment, and the submersion of the Persian Gulf submarine cable, would not, we believe, have had reason to complain of the supposed assumption of undue merit in connection therewith by Sir Charles Bright and his staff. The public, who received with unbounded satisfaction the intelligence of the successful accomplishment of the great and important work, will not lack discrimination to award the merit to whom it is due.—[Ed. T. J.]

The following additional communication on the subject of the above telegraph appeared in the *Times* of the 28th inst.:—

To the Editor of THE TIMES.

SIR.—In your impression of the 25th inst. a correspondent claimed attention for the services of Col. Stewart, in connection ith the Persian Gulf Telegraph, and I think you will agree with me, that the earlier services of Mr. W. P. Andrew, the persevering and consistent advocate of the telegraph and the railway by the Euphrates route, should not be forgotten. Mr. Andrew predicted in your columns, so long ago as the 26th of May, 1858, and on several other occasions, the entire success that would attend the establishment of telegraphic communication by the Euphrates and the Persian Gulf, and the failure of the attempt by the Red Sea, and at the time when those who were considered great authorities were arrayed against him. All the essential circumstances connected with the Red Sea Telegraph have come within my knowledge, and Mr. Andrew certainly did not overrate the physical difficulties of the route, but he did not foresee the moral ones, which in themselves would have been quite sufficient to have caused the failure of that line had the physical circumstances been as favourable as they have proved the contrary. With regard to the Persian Gulf, I will only add my conscientious conviction that, had the conduct of this affair been left to Mr. Andrew, a large saving would have been effected in cost, or greater efficiency attained. This opinion I offer deliberately, from actual knowledge.

I am, sir, faithfully yours,

24, Great George-st., Westminster, GEORGE P. BIDDER.

April 27th, 1864.

DABOLL'S FOG SIGNAL.

A VERY interesting Report has just been published, by order of the House of Commons, containing an account of all the experiments made under the direction of the Trinity Board Corporation, with a view of testing the different plans for fog signals in connection with the dangerous navigation of the Gulf of St. Lawrence and elsewhere. It appears that the Trinity Board Corporation, after a series of successful trials with the Daboll's Signal against a Bell and Holmes' Steam Horn at Dungeness Point, has determined, with the approbation of her Majesty's Government, to purchase one of Mr. Daboll's apparatus, with the view of instituting additional experiments as to its applicability for the purpose of signalling on dangerous coasts. The following are the Reports of the Committee of the Elder Brethern, who tested the power of Mr. Daboll's Fog-Horn at Dungeness in the months of December and January last. Our readers will at once perceive how, by the adoption of the telegraphic alphabet of Morse to the duration of the blasts of the trumpet, communication could be easily effected between the light or signal houses and vessels at sea both by night and day. It has long been a matter of surprise that the electric telegraph has not been adopted as an auxiliary to our system of lighthouses along our coast.

REPORT OF A COMMITTEE OF THE ELDER BRETHREN WHO TESTED THE POWER OF DABOLL'S FOG-HORN, AT DUNGENESS.

The fog-horn is placed about 500 feet from the low-water line, and 350 from that of high-water spring tides, and 15 feet above the latter; the lighthouse is distant 270 feet in a north-by-west compass bearing. The sound is emitted from a trumpet placed in about a north and south direction, and eight feet above the shingle; it is 4 feet 6 inches in length, by a diameter of 3½ inches at the smaller end, and that of 1 foot 9 inches at the mouth, which projects about 2 feet 6 inches from the southern end of the corrugated iron building erected over the apparatus.

The following programme of experiments was carefully carried out, viz.:—

	PERIODS.					
	1.	2.	3.	4.	5.	6.
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
Daboll's horn sounding . . .	12 0	12 15	12 30	12 45	1 0	2 to 3
Holmes' horn sounding at the lighthouse	12 3	12 18	12 33	12 48	1 3	—
Bell sounding at the lighthouse	12 6	12 21	12 36	12 51	1 6	—
All the above together for two minutes	12 9 to 12 11	12 24 to 12 26	12 39 to 12 41	12 54 to 12 56	1 9 to 1 11	—

The sound from Daboll's horn continues for four seconds, with intervals of 12 seconds, and which regularity the committee consider would render it a distinct fog-signal from that used by any vessels. Holmes' trumpet gives a continuous sound, and the bell strikes thirty times each minute.

The committee, consisting of the Deputy Master, with Captains Redman, Were, and Nisbet, accompanied by Professor Faraday, embarked from Dover in the "Irene," at 9 a.m. on the 17th November, 1863, and proceeded to Dungeness, the wind moderately fresh from the westward, and continuing so all day.

At 10.50, anchored to the eastward of the Ness, and informed Mr. Daboll that should he not feel perfectly satisfied with the manner in which the experiments were carried out, he was to make the same known to the committee by hauling down the colours at the lighthouse, at 3 p.m.

At noon, when distant two miles, by measurement by angles, from the lighthouse, it then bearing north, the experiments of the first period were made, during which time Daboll's horn was heard. Steamed in on the same line of bearing to 1½ miles from the lighthouse; and during the experiments of the second period Daboll's horn was heard, and that a good sound. Steamed in on the same line to one mile from the lighthouse, and during the third period Daboll's horn was heard well, and only a surmise as to any other sound reaching the vessel.

On the same line of bearing steamed in to within half a mile from the lighthouse when, during the fourth period, Daboll's horn was heard well. The bell also gave a good sound. Holmes' horn was only faintly heard; and when from 12.54 to 12.56 all the instruments were sounding together, the latter was heard in the intervals as a mere rumbling sound.

The experiments of the fifth period were heard at the same position, and gave similar results. When passing in from the lighthouse, bearing north to west, the committee observed the sound of Daboll's horn to sensibly diminish in power as the steamer passed from the axis of the trumpet to its outside edge.

At 2 p.m. the lighthouse bearing east, distant two miles, and directly to leeward of the vessel, Mr. Daboll's horn commenced to sound alone. This sound was not heard on that line of bearing until the vessel was only one-third of a mile from the lighthouse; but when crossing to the line of having the lighthouse to bear north, the sound increased in power as we approached the axis of the trumpet; and on that line of bearing the sound was distinctly heard at the distance of 2¼ miles.

At 3.15 p.m., observing the colours at the lighthouse still exhibited, the committee proceeded to Dover, when, passing to leeward of the lighthouse, the sound from Daboll's horn was heard at a distance of 4 miles or 4½ miles.

On a careful reconsideration of the result of the above experiments, made with a moderately fresh westerly wind blowing, and that the Point of Dungeness is one especially requiring fog-signals, the committee recommend to the Board that Mr. Daboll's apparatus be purchased for the sum of £500, and retained at Dungeness.

(Signed) WILLIAM PIGOTT, Deputy Master.
G. J. REDMAN.
T. N. WERE.
E. P. NISBET.

(To be continued.)

THE ATLANTIC TELEGRAPH.

IRON and india-rubber—zinc, acid, and copper—and the world is to be revolutionised! There are to be new currents in the ocean, and the torpedo is to be outdone in his own element. The dead men's bones and heaps of gold on the floor of the great deep are to be traversed by a line which goes out from the British Isles and breaks not till it reaches the shores of the New World. A large instalment of the earth's girdle is to be stretched through the abyss next spring. The biggest ship in the world—and the most unlucky since the days of the Flying Dutchman—is to have one more chance of redeeming its character. The Gutta-Percha Company and Messrs. Glass, Elliot, & Co. have gone through the transmuting process of the Joint-stock and Limited Liability Acts, and, having been duly amalgamated, now stand out before the world with the unmusical title of the Telegraphic Construction and Maintenance Company. Let us hope that this quaint yet business-like appellation will be happily verified in the case of the great Atlantic cable, and that the Anglo-American telegraph, being duly constructed, will be effectually "maintained." Further, let us hope that the said cable will also "maintain" the dividends to be anticipated by the shareholders in the Atlantic Telegraph Company, at whose instance Messrs. Glass & Elliot have taken up the contract, which, of course, now merges in the operations of the new amalgamation just referred to. If the Great Eastern does her duty in this important enterprise, we will forgive her all the naughty tricks and prodigious extravagances of which she has been guilty, and pronounce her past offences for ever expurgated. On the contrary, if she goes rolling about, broadside on, and upsets

everything, we shall vote the Leviathan an incorrigible plague and a scourge to the human race. Capitalists have already flung a hillock of gold into the sea, in a fruitless attempt to link the New World to the Old in an electric chain. Another hillock is growing up, and simply to throw one after the other would be something too provoking, even for the patience of that most enduring creature, the modern shareholder. Let us hope for the best. If the Great Eastern does her duty on the forthcoming occasion, £50,000 in paid-up shares of the Atlantic Telegraph Company will reward the proprietors, and the glorious results of electric communication between the two terrestrial hemispheres will delight the world. The "United States" may then be taken to represent —not a mere American federation—but the relationship subsisting among all the civilised nations of the earth.

Surely our modern science will accomplish this most desirable feat? True, it is "no narrow frith" which our engineers propose to cross. But the skill which can bore a tunnel through the Alps, and build such a monster of the deep as Brunel's gigantic ship, can lay a cable at the bottom of the sea, even though the line be some thousand miles in length. War is doing wonders. Big guns are crashing through iron and steel, and the thunders of the battle-field and the siege outvie "the bolts of heaven." The triumphs of peace must be extended. Let the "batteries" of the electrician contend with those of the warrior. Let the messages of commerce and trade, of friendship and congratulation, supersede the missives of war and the dispatches of contending generals. Let us hope that the deep-sea telegraph will be "a bond of peace." It is not England's fault if belligerent murmurs traverse the Atlantic.—*Standard.*

MR. COOKE'S PAMPHLET OR SKETCH OF 1836.

(*Continued from page* 200.)

Our readers are now in possession of the whole of Mr. Cooke's sketch, with the exception of a few *Notes*, which we now append. The pamphlet is a valuable contribution to telegraphic literature. It shows that the writer had bestowed much thought and labour on the subject, and at a time when but few were ready to receive his project as capable of practical realization. We will here quote the opinions expressed by a gentleman of high scientific attainments after perusing the sketch in January, 1837. Dr. Reynolds of Liverpool, writing to a mutual friend, observes, "He (Mr. Cooke) appears to me to underrate the practical difficulties of maintaining a wire extending for many hundred miles in a state of perfect integrity and electrical insulation; and unless he has two wires of communication, he would, I conceive, be liable to the inconvenience of the parties at each extremity signalling at the same moment of time, and the effect being thus destroyed." Dr. Reynolds by no means stood alone in his "doubts and perplexities" as to the future of the wonderful invention. Professor Daniell, who had for years witnessed the profound researches and investigations of Professor Wheatstone, exclaims, "I had followed, as you well know, all your (Professor Wheatstone's) experiments from the beginning, and was intimately acquainted with both the principle and construction of your apparatus; but, nevertheless, when I saw it in action upon the Birmingham railroad, I was struck as with something quite new. The facility with which I could myself immediately read signals communicated from a distance; and the simplicity of the means by which I saw you reply to them, and which I felt that I could master in five minutes, produced in me something of the *feeling of magic.*" Such were few of the incidents in connection with the early introduction of electro-telegraphy. It has been the habit of late, on the part of some of our writers, to characterise the electric telegraph as a "child of many fathers," and to ignore to too great an extent the indefatigable labours and the ingenuity of Messrs. Cooke and Wheatstone, in despite of the emphatic opinions expressed by the late Sir M. Isambard Brunel and Professor Daniell, that "whilst Mr. Cooke is entitled to stand alone as the gentleman to whom this country is indebted for having practically introduced and carried out the electric telegraph as a useful undertaking, promising to be a work of national importance, and Professor Wheatstone is acknowledged as the scientific man whose profound and successful researches had already prepared the public mind to receive it as a project capable of practical application, it is to the united labours of two gentlemen so well qualified for mutual assistance that we must attribute the rapid progress which this important invention has made during the five years since they have been associated." We have already observed that the history of the electric telegraph has been but imperfectly told, and that amongst the many thousand of individuals now connected with telegraphic undertakings, as directors, shareholders, and employés, there are but few, comparatively speaking, acquainted with the history of the most important invention of modern times—an invention which day by day becomes more appreciated as the speedy promulgator of human thought, its joys and its sorrows, its hopes and its fears, and in facilitating the social, commercial, and political exigencies of the civilized world.

NOTES.

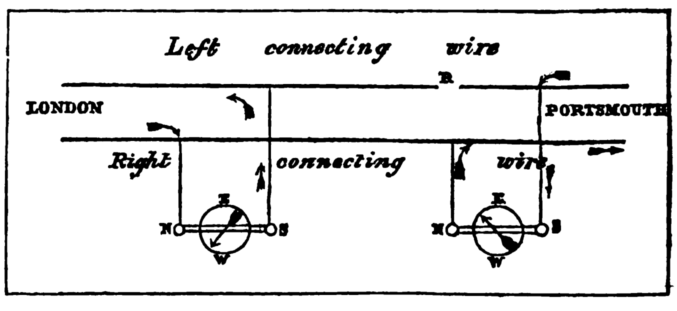
I. This instrument is capable of representing in rapid succession sixty letters, figures, and symbols, with a distinctness which admits of no mistake. (See page 190).

II. Any number of instruments may be attached to the same conducting wires. Hence, if telegraphic intercourse is to be established between two distant places, the wire laid down for this purpose may be connected with an instrument at every town which it visits throughout its course. In such combinations, whatever symbol is represented on any one instrument immediately presents itself on all the rest. (See page 190).

III. The following plan for the construction of a conducting trough is recommended by the projector, as the cheapest and most durable which has occurred to him, offering at the same time an effectual mode of isolating the wires and of protecting them from decomposition. He proposes that the wires be laid in separate channels formed along the surface of narrow slips of baked wood, and covered in with a thin lath of the same material, and that this case be inserted into a trough of thick semicircular draining tiles about three or four inches in diameter, the space between the wood and tile being filled with waterproof cement, the whole may be guarded above by a flat tile and buried from eighteen inches to two feet in the ground. Through large towns, where the streets are frequently disturbed for the laying of gas or water pipes, iron pipes (the wires being isolated by wood) might be preferable. (See page 190).

IV. As no interference with common or rail roads is permitted, except under the direction of the authorities, timely notice to the proper quarter would be given, if the repairing of a bridge, the laying of drains, the lowering of a hill, or any other work likely to disturb the wires, was about to take place, when a new or temporary line of wires would be completed along the disturbed space before the old one was removed. (See page 190).

V. That the use of this instrument, which we will call a "detector," may be more fully understood, the following explanation and diagram is subjoined. The detector resembles a small pocket compass, with a coil of copper wire or a multiplicator fixed across the dial plate from north to south, terminating at the extremities in cups for mercury; when used, the dial plate is adjusted to the magnetic meridian, so that the needle, when at rest, becomes parallel to the wire. If a current of positive electricity be passed along the wire in the direction of N S, the north pole of the magnetic needle, will be deflected towards the west; if in the opposite direction, the effect on the needle will be reversed, the north pole of the needle deviating to the east; let L P be two places between which the connection has been broken off at the point, R. The telegraphic instruments at both places are so arranged that upon being set the positive currents tend to flow from each telegraph in the direction indicated by the arrows. Whenever the detector is applied to the branch wires, it completes the galvanic



circuit either with the telegraph at L or P, according to the side of R, on which the experiment is made; and as the right branch wire from L is always placed in connection with the north cup, and the left branch wire with the south cup of the detector, it is manifest from what has been said that, so long as these experiments are made between L and R, the deviation of the north pole of the needle will be westerly, and that it will be easterly on the other side of R, thus indicating the direction of the injury. (See page 199).

VI. In Government business, the delay occasioned by transposing the signals might be avoided, and further advantages secured when the despatches passed through confidential hands only, by having a distinct apparatus, secured from access by lock and key, in connection with the general line of wires, in which the order of the symbols might be differently

arranged, so that the signals represented on the other instruments, through which the communication passed when the Government telegraph was working, could have no connection with the sense of the Government dispatch, which would nevertheless be expressed in the ordinary numbers, and in reference to the published signal. If any further precaution were required, a signal-book differently numbered, or a supplement to the published one, containing names, important expressions, such as "war," "riot," "military," &c., might be used for further security, or a trifling periodic change in the arrangement of the symbols, requiring only a minute or two for adjustment, would baffle the most skilful decipherer. (See page 200).

VII. The periodic announcement of this and other great markets would occupy but little time, for by allotting to certain important intelligence of frequent occurrence the lower numbers (say from 10 to 99, which require only two signals to express, and which would be readily recognised in practice), on the expected signal appearing about the usual time, the clerk would take up a printed form and fill up the blanks as the signals appeared. The order in the details of each report would be uniformly observed, as they would be given from a similar printed form filled up by a responsible person. (See page 200).

THE UNITED KINGDOM AND THE BONELLI TELEGRAPH COMPANIES.

The daily papers have, for some weeks, been the exponents of somewhat angry discussions between the above companies. The question at issue seems to be the relative merits of now two well-known instruments, namely, the *Bonelli*, and the *Hughes*.

The United Kingdom Telegraph Company insists that the *Hughes*, their sole property, is capable of transmitting, in a given time, a greater number of messages, employing only one wire, than the instrument of the Bonelli Company, which requires five wires. The first-named company, however, stipulates that as it uses both for the *Hughes Printer* and the *Morse Ink-writer* only one wire each, the result, in every case, must be multiplied by five for work performed and cost of performing it, so as to equal the five wires used by the Bonelli Company, or, as we understand it, that one of Bonelli's instruments is challenged to work against five of Hughes's and Morse's. We shall look forward for the result of the competitive trial with considerable interest, as not only likely to establish the respective merits of two very valuable and ingenious instruments, but as a step towards extending the advantages of telegraphic communication. We believe that both instruments would find ample remunerative employment were their adoption to become more general. We have had several opportunities of witnessing the marvellous rapidity and certainty with which communications are effected by means of both systems.

We append the proposals submitted by the United Kingdom Telegraph Company as the basis for the competitive trial, reserving our comments for the present:—

United Kingdom Electric Telegraph Company (Limited).

Proposal for a Competitive Trial of the system used by the United Kingdom Electric Telegraph Company and that of the Bonelli Telegraph Company, between Liverpool and Manchester, and for the proof that the necessary use of five wires constitutes an impracticability for a commercial-remunerative system:—

That the trial shall be of such a character as to afford really satisfactory evidence of the merits of the respective apparatus.

That, to attain this, it is necessary to try the apparatus in all weathers, for correct and useful purposes, and under similar circumstances to those under which ordinary telegraphic correspondence is performed.

That the trials should, therefore, extend over a period of at least fourteen days, so as to afford proof that the instruments continue in reliable and regular working order.

That any derangement in the system under trial is not to be corrected by recourse being had to any other system for an exchange of instructions, or other communications.

That each system shall be clearly explained before the trial, and the whole of the apparatus used be fully shown and described; the mechanical, electrical, and chemical arrangements gone through; and that all these points shall be taken down in writing, and no departure from them be allowed.

That any change or increase, or diminution of electrical or chemical power may be made.

That the basis performances of the Bonelli apparatus, published in the prospectus of that Company, be taken as a fair basis of work to be performed.

That the statement made in the same document, as to the Bonelli working between Liverpool and Manchester, be also taken and gone into as [a fu]rther basis.

[T]hat each Company shall take the number of wires required to work one apparatus of each kind and no more, although that number of wires may be reduced if practicable.

That an account of the number of messages received and sent for the public between Liverpool and Manchester for the past six months by each Company, and the time occupied in their preparation and transmission, shall be delivered as proof of the actual electrical working capabilities of the two Companies' systems in positive practical work, the object of a trial being to arrive at practical results.

That in like manner the staff employed to perform the above work, and the expenses incurred, shall also be taken as a further practical business-like proof of the relative cost of the different systems.

That for the fourteen days named several hundred messages per day shall be exchanged by each Company between Liverpool and Manchester, on each system employed by such Company.

That the messages sent by both Companies shall be, in all cases, fac-similes.

That news expresses shall also be sent, as above, of several columns of the ordinary description of matter forwarded by reporters for the press.

That neither Company shall be made aware beforehand of the number of messages to be sent, nor of the amount of press matter to be forwarded.

That messages and press matter shall all be treated exactly as if to be made use of, and shall be preserved and noted accordingly.

That the working from each end shall be from the same room, each Company providing its own wires and clerks.

That the staff employed and wages paid shall be declared beforehand, and be strictly adhered to.

That the working shall be before and after the most busy hours of the day, as may be arranged.

That as the United Kingdom Company uses for both the Hughes Printer and the Morse Ink-writer only one wire each, the results in each case be multiplied by five, for work performed and cost of performing it, so as to equal the five wires used by the Bonelli Company.

That each message or express shall be timed when it is begun and when finished, to date from the beginning of either Company's operations to prepare for its transmission. That each Company will be expected to work up to the maximum of its respective system.

That each system shall also be tried upon extended lengths of wire, in bad weather, as a proof that the Bonelli system can or cannot work under such circumstances.

That the same description of proofs be gone through as for the short line between Liverpool and Manchester.

That for these latter experiments the United Kingdom Company allow the Bonelli Company to make use of the United Kingdom Company's wires, or the Bonelli Company may arrange with any third company.

That for the purpose of proving the impracticability of a five-wire system, the United Kingdom Company shall go fully into the cost of such a system, the capital required, and the practical difficulties in its way, and that the Bonelli Company shall in like manner be called upon to prove its practicability, the number of wires to be applied on each circuit, the staff to be used, the offices, &c., and the general cost of establishing and working such a system in every particular. These statements and calculations on both sides to be in writing.

That for this purpose the available capital of the Bonelli Company, after all liabilities are met and discharged, including patent rights, if any, shall be declared, as the capital available and required are essential elements of the question.

That statements having been made to the effect that the Bonelli apparatus was working in France, the Bonelli Company be invited to show where it is at work, or if it has been adopted, and that the United Kingdom Company may show, in like manner, if the Hughes is adopted officially by the Government of France, and if its use is being extended there and elsewhere.

That the Worshipful the Mayors of the respective towns or the Presidents of the Chambers of Commerce, or some other equally independent parties, be chosen to arrange with the Companies the details of the work to be delivered to the Companies, and to record the results.

Magnetic Storms.—Did any doubt remain of the electrical character of the *aurora borealis*, it would be removed by the phenomena presented by the needles of the telegraph, and often by the bills during the prevalence of this meteor. At such times the needles move just as if a good working current were pursuing its ordinary course along the wires; they are deflected this way or that, at times with a quick motion; and changing rapidly from side to side many times in a few seconds, and at other times moving more slowly and remaining deflected for many minutes with greater or less intensity, their motions being inconstant and uncertain. These phenomena have occurred less frequently on the part of the line between Reigate and Dover, which seems nearly east and west, and on the part between London and Reigate, which is nearly north and south. When, however, they do make their appearance on the telegraphs in those parts, we are prepared to expect auroral manifestations when night arrives—and we are rarely disappointed. The deflections in their variations appear to coincide with the various phases of the aurora. On the branch line running from Ashford to Ramsgate these deflections have been a much more common occurrence, even when the other parts of the line were unaffected, and when no auroral phenomena were noticed.—*C. V. Walker, F.R.S.*

ON THE PATENT LAWS.

We have great pleasure in reproducing in our columns the following paper on the Patent Laws, by Thomas Webster, Esq., M.A., F.R.S., which appeared in the *Journal of the Society of Arts* on the 22nd instant, and we purpose laying before our readers the very interesting discussion which succeeded its reading at the Society of Arts :—

The Council of the Society having suggested that a discussion on the Patent Laws might be of service during the present session, I have much pleasure in preparing a communication for the purpose of facilitating the full consideration and discussion of the subject.

It is one of the peculiar characteristics of this ancient Society—the first and for a long time the only representation of practical science—that its comprehensive character permits it to take the lead in any movement relating to the Arts, Manufactures, or Commerce of the country. The committee to which "The Patent Law Amendment Act, 1852" is due met first in the house of this Society. Other committees of the Society have from time to time reported on this subject in the years 1850, 1851, and 1852, and the recent communication of the chairman of your Council to the Social Science Association, at its meeting last year, at Edinburgh, is a valuable contribution to the history of the progress of opinion on this subject.

It is not my intention on the present occasion to treat of the general jurisprudence of the subject, by entering on an elaborate discussion of the origin or grounds of the principles upon which property in the exhibition of mind, as embodied in material forms, may be considered to rest. The origin of such property, the grounds upon which it rests, whether on natural right, on policy, or expediency, the protection of such property by laws of the land, without which the name of property is but an empty sound, have been repeatedly treated of.

My object on the present occasion is to treat the subject practically in reference to the general policy of the patent laws, and with the view of ascertaining facts and eliciting opinions on certain questions which the consideration of the policy of those laws involves. That the subject has difficulties peculiarly its own is not to be denied; whether such difficulties may be greatly modified and lessened, if not altogether removed, is one of the questions at issue. Hitherto no attempt has been made to grapple with these difficulties, the provisions for this purpose contained in the Patent Law Amendment Act having remained in abeyance.

Considerable differences of opinion may be expected as to the most appropriate remedies for the admitted grievances, but I believe that should the discussion of the subject be fully exhausted, there will be a great preponderance of opinion in favour of the views with which the Patent Law Amendment Act of 1852 was proposed and supported.

In entering on this subject it will be convenient to premise that the real question at issue may be considered under the following heads :—1. Whether inventions should be encouraged and inventors rewarded. 2. Whether any more practicable means of encouraging inventions and rewarding inventors exist than a system of patents. 3. The best means of creating and protecting such property. No one, to my knowledge, has yet advanced so far in liberalism as regards the rights of property or the encouragement of inventions, as to deny or seriously dispute all those propositions. Such heresy, so to speak, has not broken out into open flame, however it may be smouldering, and appear to be involved in the ashes of doctrines which have occasionally been announced, or underlie the surface of opinions which have been advanced, and will come under discussion on the present occasion. The President of the British Association (Sir W. Armstrong), at Newcastle, and your Chairman of Council (Mr. Hawes), in the paper already referred to, give expression to the opinion that the seeds of invention strewn broadcast over the world by the previous investigations of learned men, are published and given to the world, ready to germinate in due season whenever the occasion or necessity may arise, and that legislative interference will neither produce them nor stimulate their growth. This opinion, proceeding from, or endorsed by, such authority has been, and will be, often quoted as condemnatory of all views favourable to property in invention, and in support of the views that invention does not require the stimulus of the reward or remuneration which the Patent Laws are designed to confer. From these premises it is contended that new processes or new mechanical contrivances, derived from information thus freely and gratuitously published, are public property, and cannot belong to those who merely give such knowledge a practical form. But is not this to beg the whole question? Is there not also some confusion arising from the use or imperfection of language? Is a proper distinction always maintained between discovery and invention in reference to these questions? A law of nature, as gravitation, or a machine, as the steam-engine, or a process, as vulcanising, are spoken of indifferently as discoveries or inventions. This confusion of language is fruitful of difficulty in the subject under consideration. We speak of discovering a law of nature, as gravitation, cohesion, elasticity, attraction, heat, atomic theory, equal transmission of pressure in fluids, elastic and inelastic; we discover (Fr. *découvrir*) that which has a prior or actual existence in nature; we do not invent such law. In the proper sense of the term, invention is more in the nature of creation than of discovery. We invent or find out a mode of doing, that is, of producing a particular thing; every new manufacture is in that sense a creation. To call it a discovery is to introduce a confusion in the use and application of terms; or, to add one further illustration, we speak of the discovery of vaccination and of the invention of the penny postage, neither of which could be the subject of the patent laws. The inventor applies the laws of nature; invention consists in the application of such laws. For instance, Watt's invention of the steam-engine was an application of the laws of heat; Dollond's achromatic object-glass, of the laws of light; Wollaston's camera-lucida, of the laws of refraction and total reflection. Vulcanised rubber was a new creation; such a thing had never existed before, the invention consisting in the application of heat and sulphur to rubber under certain conditions. Photography was an invention in the strict sense of the term; *i.e.*, a picture so produced was a new creation, a new manufacture. The self-acting mule, the product of the genius of Richard Roberts, whose loss we so recently have had occasion to deplore, the regenerative furnace of Siemens, the automatic self-recording telegraph, the last production of Professor Wheatstone, the various forms of telegraph or telegraphic cables may with propriety be called new creations, or, in the language of the Patent Law, new manufactures. Seeing, then, that invention consists in the application of the laws of nature to the matter provided to our hands, in giving to such laws a practical form, how can it be said that property cannot be acquired in the application of knowledge given to the public? That is the very foundation of the system. The distinction above adverted to is more important than may at first sight appear. The correct and appropriate use of terms is a matter at all times deserving consideration, but especially so when it is the foundation of distinctions in reference to the subject under consideration. Thus, for example, M. Legrand, insisting on the distinction between patent right and copyright, on the incontestible difference between the work of the writer or author of a literary composition and the inventor, says, "If Masillon had not written '*Le Petit Carême*,' no other person could have done it. If, on the contrary, Niepce had not discovered photography, some one else would have invented it. What do we say? Another has invented it. Daguerre has had the same idea. Artists really create something; they produce work which no other would have produced. In the domain of industry, on the contrary, the inventor is not, properly speaking, any more the creator than he could be the exclusive possessor. He finds; he discovers; but he does not create."* The confusion of the above needs little comment; an idea not carried out is no invention. It is matter of law that a patent cannot be granted for a principle or an idea, but only for its application or embodiment; thus there could be no patent for the discovery of a law of nature or property of matter, unless applied or embodied in a manufacture. In litigated cases, the question whether the subject of the patent is a principle or a manufacture not unfrequently arises. The following observations of a highly scientific and most learned man, Mr. Baron Alderson, are worthy of special attention: "I have always thought that the real test was this, that in order to discover whether it is a good or a bad patent, you should consider that what you cannot take out a patent for must be considered to have been invented *pro bono publico*—that is to say, the principle must be considered as having had an anterior existence before the patent. Now supposing in Watt's case it had been known that to condense in a separate vessel was a mode of saving fuel, then Watt certainly could have taken out a patent for carrying into effect that principle by a particular machine; but then his patent would have been for a machine; and if I invented a better machine for carrying out the principle, I should not infringe his patent unless my machine was a colourable imitation."

The distinction now insisted on is little regarded by many who speak of patenting ideas and principles, and derive an argument from the abuse rather than the use of the system, and assume that to be part of the system which by law is illegal.

But it is said that inventors need no such encouragement, that invention is a real pleasure; that true inventive genius labours on involuntarily; that the glory of a great name or the possible reward of a grateful nation is a sufficient stimulus; that the philosopher, physician, and chemist give their results to the public, who appreciate originality of mind, and do not fail to reward it. All this may be true, but it applies to the labourer in the field of discovery rather than invention. I remember on one occasion, at a meeting at Manchester, when this doctrine was propounded, that Richard Roberts replied: "The patterns of that particular invention cost me £500; they would have been 'colted' (that is, copied) the next day but for the Patent Laws." The gratitude of the public is soon exhausted when the benefit is reduced into possession.

However great may be the stimulus of the pleasure of invention, the advocates of this view would appear to lose sight of or disregard the fact that the invention and the public require adaptation to each other; that the introduction of an invention involving any material change is a constant struggle with the existing state of things, and in a large class of cases is as much an education as the training and introduction of a child; that it is a contest with existing practice, in which contest the inventor has to struggle with all the prejudices, capital, and influence of the existing trade and established manufacture. The history of the struggles of the introduction of new invention, as detailed on the hearings before the Judicial Committee of the Privy Council in cases of application for the extension of the

* See "The Patent Question," p. 17, by R. A. Macfie, papers at Edinburgh Meeting of Social Science, 1863.

terms of patents, can hardly fail to produce the conviction that these struggles would never have been undergone but for the expectation of the reward. Many inventions are wholly in advance of the age, and would fall still-born but for the return anticipated on the capital embarked in their introduction. There was, it is said, no patent for paper (A.D. 1200), or for oil (1297), or for glass (1300), or for the mariner's compass (1302), or for printing (1430), or for gunpowder (1450), or for many other useful inventions of world-wide utility, and therefore it is left to be inferred that encouragement to invention or reward to the inventor in the nature of the patent system is unnecessary. Until the wants of mankind or the isolated efforts of mighty minds in the progress of civilization had formed the alphabet, so to speak, or laid the foundation of practical arts, there was nothing out of or upon which the superstructure could be raised. Because skins or the hand-made fabric once served for clothing, can it be contended that the progress of industry and of the practical arts has not been most materially stimulated by the expectation, however delusive, of reward and pecuniary remuneration?

Books were compiled and written before and without any copyright laws, but does any one adduce this as an argument against the justice or expediency of these laws, the analogy of which to the patent laws can hardly be denied, notwithstanding the distinctions which may be drawn between them? It is said that things belonging to the province of copyright are an embodiment of the individual mind, which no other mind would have made, whereas things belonging to the province of patent right are capable of being made by many minds, of being originated in the same identical form by a plurality of persons—that the inventor has, in fact, only forstalled time, and that it may be presumed that the invention would have been made at some time by some other person, and would certainly have been made so soon as the want should arise—that to infringe copyright is slavishly to imitate, whereas patent right may be infringed without such imitation. The subject of copyright is one specific combination of words, letters, and lines, in this respect similar or analogous to the specific combination constituting a machine, or to elements arranged in a certain order, whereas in many cases inventions may be exhibited in various material forms, carrying out or subservient to one leading idea. Different minds do not hit on the same means for carrying out the same idea or of attaining the same object. Invention is one continuous process of simplification, as the history of invention clearly shows. In cases of copyright the identification is easy, speaking to the eye or the ear, whereas in cases of patent right the identification is sometimes difficult, inasmuch as, to the eye, the material forms may be different. These distinctions point only to the difficulties of the subject, and must be dealt with accordingly; but the principle of property in both is the same, namely, a recognition of right in the product of the brain, as embodied in a material form. Invention being one continual progression, each stage in advance of the preceding cannot fail, in many cases, to provoke the opposition of the capitalist, who may look with little favour on the changes which a great improvement necessitates; his old mill may have to be refilled with new machinery. Again, the capitalist in mind who can devise an expedient for overcoming any difficulty so soon as it arrives, may not be pleased by finding that he has been forestalled by some other person; that he must respect the property which the law gives to possession, and adopt some other, and perhaps inferior, means of attaining the same end, or come to terms with the owner of that property. Hence, patents have been called obstructive, likened to toll-bars on the highway. Authentic instances of such obstruction would be a great boon, and contribute much to the history of the subject; they have been often asked for, very few have ever been even pointed at. If such exist to the extent contended for, or to any extent, the remedy is very simple—make a license under a patent a matter of compulsory purchase, to be settled by arbitration on a review of all the circumstances of the case. If the owner of land or houses has to restore to the public a portion of the ancestral property acquired from the public in former times, there can be no great injustice in requiring a patentee, on fair and proper terms, to admit others to share in that which he may be regarded as having acquired from the public; in this sense that same other person, it may be presumed, would have made the invention when the emergency arose. The patent might be granted on this express condition, and the effect of such a system immediately tried. But philanthropic and moral considerations are introduced. The system is denounced as a lottery, and injurious to the personal interests of the inventor, who rarely obtains the reward which he expects, or to which he may be fairly entitled. Is this not part of the lottery of life? The race is not always to the swift, nor the battle to the strong. The very objection assumes an expenditure of time, labour, and money in producing a result beneficial to the public, though not to the individual author. Let such an individual be rewarded out of the "Inventors' Fee Fund," the surplus fund to which he has contributed. Let this blot be removed. Let it not be said that a great benefactor to the public has been unrewarded, when ample funds exist of the inventor's own creation, out of which he may be amply compensated. Let it not be said that the name of one of our greatest inventors, just removed from amongst us—Richard Roberts—should be without a national tribute for the emancipation and development of industry, of which the self-acting mule was the pioneer, or that the family of the man should be permitted to want in the midst of the untold millions which his inventions have added to individual and national wealth.

But the principle of patents is said to be inconsistent with the principles of free trade. Here, again, I cannot but think there is some misconception and confusion in the use of language. The theory of the patent law is the creation of a trade, or, as expressed in one of the earliest reported cases, "when any man, by his own charge and industry, or by his own wit or invention, doth bring any new trade into the realm, or any engine tending to the furtherance of a trade that never was used before, and that for the good of the realm the king may grant him a monopoly patent for some reasonable time, until the subjects may learn the same, in consideration of the good that he doth bring to the commonwealth, otherwise not."* It has been said that these principles are not now applicable, that all trades are established, and that the reason does not apply, there being no necessity for the instruction; but such an observation is made regardless of the fact that knowledge and invention are progressive; that if there be not the same ignorance as in bygone centuries, there is a special opposition, which our very civilization has created, rendering the special property in an invention the best means hitherto desired, if not the only means, for ensuring that progress which all profess to desire. It may then be assumed that new trades, or improvements in existing trades—which, for the question under consideration, may be regarded as new trades—are still to be created, and that it is the object of the patent laws to foster inventions constituting such new trade. The fostering care of special property in the invention is continued only for a limited and reasonable period, until the trade shall have been established; during that period the particular trade is not to be practised or special property shared without its owner participating in the proceeds; when that period has expired the trade, whether established or not, is open to all, with this further advantage, that a description of the manner of practising the invention is open to all; the requirement of such a description—called the specification—having been substituted in the reign of Queen Anne, in lieu of a proviso appearing in some private acts for patents requiring the patentee, during the latter half of the term granted, to take apprentices and teach them the knowledge and mystery of the said new invention.†

The principles of free trade can have no application to a trade which is non-existent, or which has to be created. If, as the theory assumes, special property in an invention be essential or materially conducive to the creation of the trade, to prohibit such property is to prevent or delay the establishment of the trade. The supporters of this objection would appear to confound patents for inventions with the exclusive privileges declared to be illegal by the Statute of Monopolies (21 Jac. I., c. 3, A.D. 1624). It is contrary to the principles of free trade to restrain any person from, or subject him to a tax for practising, any existing trade as a baker or brewer, or buying and selling in the cheapest market, but it can hardly be said to be contrary to the principles of free trade to give exclusive privileges for the creation of that which does not exist, for a trade to become free as soon as established.

The real question would appear to be as to the terms or conditions upon which such privileges should be granted, and not to the principle of such privileges. If patents are granted improvidently, there is an abuse of the system; remove the abuse, but do not found on the abuse an argument against the use of a system, unless such abuse is incurable and inevitable.

The abolition or diminution of secret practices, with their long train of attendant evils, has frequently been relied on as an argument in support of the patent system; and the freedom with which the knowledge of inventions is now given to the world has been relied upon as one of the great improvements due to the passing of the "Patent Law Amendment Act, 1852." This, however, in the able paper of the chairman of your council on the economical effect of the patent laws, is objected to as inducing the circulation all over the world of the best possible descriptions of our most recent improvements for the benefit of our rivals. Is this generosity really detrimental to our national interests? Can any well-authenticated instances of that detriment be adduced? Isolated cases may exist in which some particular interest may, under special circumstances and for a limited time, be prejudiced. This is a practical test, and capable of proof; and if it should appear that in some few cases the result may be that the foreign manufacturer, by means of such information, may be enabled to compete successfully with the home manufacturer, either at home or in the markets of the world, are not the compensating advantages such as greatly to outweigh or overbalance the supposed detriment? Is such detriment in any respect comparable to the evils of the secret system of the guilds of our forefathers, when art was a mystery and trade a protected monopoly?

Are not the objections, when thoroughly examined, directed to the administration rather than to the principle of the system? Is not the proper course to reform the system—at least to make the attempt?

Time will not permit me to pursue this part of the subject in detail on the present occasion; it may be sufficient to point to the proposals which have been made for removing or mitigating the admitted evils of the present system, and which may be classed as follows:—

1. That patents should not be granted as of course, but that some check should be placed on their indiscriminate issue by a preliminary inquiry and report, by which the applicant would receive the benefit of the accumulated experience of the office of the Commissioners of Patents in consideration of the fees paid.

2. That the validity and infringement of patents should be tried by a

* See 1 Webster, "Patent Cases," p. 6.

† See Act for Bank's Invention, A.D. 1651, c. 2; 1 Webster, "Patent Cases," p. 28.

judge, assisted by two or more assessors conversant with the subject selected by the parties or by the judge, from a panel provided for the purpose.

3. That the owner of a patent should be required to grant licenses, or to sell the whole right for the benefit of the public, on adequate consideration.

4. That the fees paid on patents should constitute an "Inventors' Fee Fund," to be applied wholly to inventors' purposes, to the reward of meritorious inventors, to the repurchase of patent rights, and the advance of practical science.

TELEGRAPHIC NEWS.

The Brett Collection.—The sale of this recherché collection of works of art and objects of vertu realized the handsome sum of £13,000.

United Kingdom Electric Telegraph Company (Limited).—This company announce that they have now opened their lines to Edinburgh and Leith. Messages of twenty words 1s. between any of the company's stations.

Presentation.—A very handsome and valuable gold watch has been presented to J. R. France, Esq., Acting Engineer to the Submarine Telegraph Company, by the Directors of the Steam Tug Company, as a recognition of his gentlemanly and courteous conduct while engaged in restoring the submarine cables in the German Ocean.

Mr. Reis' Acoustic Telephone.—It has long been known that a magnetic current will produce a sound in wires of iron and other metal. Mr. Reis takes up this fact, and has constructed an acoustic telegraph or telephone, an instrument which delivers a message by sounds of different pitch. As yet it is far from perfect, and to many ears there is no perceptible difference in the tones, but as the possibility of communicating between different places by sounds has been demonstrated, we may expect to hear again of the subject.

East Indian Railway Company.—By the thirty-fifth report of the directors of the East Indian Railway Company, it appears that the electric telegraph is now in working order from the Kurrumnassa to the office in the Lelinghur, at Delhi—a distance, with branches, equal to 556 miles. There are 45 stations at work, from which the number of messages sent amounted to 124,878 as against 106,050 in the previous half-year; the receipts from private messages amounting to Rs. 8,935 3a. as compared with Rs. 5,969 1a. in the previous half-year. The laying of two additional wires, making four in all, has been commenced from the Kurrumnassa. The telegraph has been worked very satisfactorily.

Iron and its Appliances.—Professor Fairbairn, in a recent lecture on this subject, at the Dumfries Mechanics' Institute, thus referred to the manufacture and laying of submarine telegraph cables:—"If a heavy weight were suspended to a piece of the cable, the copper wire, which is exceedingly ductile, would be drawn out; the gutta-percha covering would also expand; but on the removal of the weight, the insulator, being elastic, would contract, but the copper wire would not go back: the result of which was, that the contractile force of the gutta-percha had a tendency to double up the wire, and push it through the insulator: so that when the cable was being paid out there was the risk, wherever the cable came in contact with the water, of the electric current passing into the sea, and the wire thus becoming useless. This showed how very cautious and careful they should be in the construction of such cables, in order to see that any part of the cable when put to a severe strain should harmonize with the other parts of it."

Auckland.—The *New Zealander*, of the 30th January, states that the extension of the electric telegraph to Ngarawahia was progressing rapidly, and that already the line had reached Koheroa, and would in a few days be completed as far as Meremere. Strong covering parties were employed for the safety of the workmen engaged.

The New Zealand papers received by the last mail state that the materials required for the completion of the electric telegraph between Invercargill and Bluff Harbour, Southland, had been received; and that, under the chief superintendence of Mr. Weldon, the inspector of telegraphs, the line had been very speedily placed in working order, and messages have been since regularly transmitted between Invercargill and the Bluff. The convenience to the commercial interest had been found to be very great, and the extension of the line was likely to take place very shortly. The instruments for the line were supplied by Messrs. Siemens, Halske, & Co., of London.

New Zealand.—The *Lyttleton Times*, with respect to the extension of the telegraph to India, viâ the Persian Gulf, observes:—"We cannot be otherwise than deeply interested in the success of the expedition, for at any rate the Indian telegraph is of the greatest importance to these colonies. Amongst the objects contemplated is the immediate restoration of communication between Batavia and Singapore; and it is expected that the Dutch Government will construct or subsidize a line to Ceopang, in the island of Timor. From this point we may look forward for telegraphic communication to this continent at no distant day. Already the South Australians are pushing forward to colonize Arnheim's Land, as, and from Queensland, a route is opening up for stock along the Gulf of Carpentaria. It will remain with ourselves in a great degree to take early advantage of such an event; at any rate, we may be sure that an overland line will soon bring these southern communities into the great Indian submarine route."

The following notice has appeared in the daily papers:—"Challenge to Bonelli's Telegraph Company.—Had the challenge from the United Kingdom Telegraph Company to test the relative merits of Hughes's and Bonelli's systems of telegraphy been fairly made, the directors having at once accepted it, would have awaited the result without further action. But the evident animus of its contents, the repetition of the advertisement long after acceptance, and the statements it contained, are so calculated to mislead, that they feel bound to give them an unqualified contradiction; they, therefore, append the following extracts; and, appealing from the assertions of a company, whose very existence is threatened by the establishment of a sixpenny rate for messages, to the opinions of men of highest authority, who have tested the system, leave the issue to the public. The United Kingdom Company state that Bonelli's system is slower, more costly, and impracticable, carefully shunning correctness, in which Hughes' is so deficient and Bonelli's so perfect. That it is practicable, is proved by the fact that the system has been at work between Liverpool and Manchester since September last, without a single interruption from weather or electrical causes. Mr. Fleeming Jenkin says: 'It is more rapid than any other printing arrangement with which I am acquainted—except, perhaps, Caselli's. Bonelli's system can, in my opinion, be profitably and economically worked under good management.' Mr. Henley says: 'I have carefully examined Bonelli's printing telegraph, working between Manchester and Liverpool. I consider it decidedly the best type printing telegraph yet invented, very simple in its construction, there being a total absence of complicated machinery, and not liable to the errors (caused by wrong letters being printed) which so frequently occur in other type printers, and which, from the little reliance to be placed on them, has prevented them from being used.'"

Cape of Good Hope Telegraph Company.—At the ordinary general meeting of the shareholders in this company, held on the 27th inst. at their offices, 25, Poultry, Mr. J. A. Radecliffe in the chair, the report was unanimously adopted. It stated that the cable had been well and substantially laid by the contractor, and had recently been opened. They could not say much for the traffic at present, because it had been opened so recently; but from what they had seen of it, they were quite satisfied it would prove remunerative to the shareholders. They had made arrangements with the Electric and International Telegraph Company, by which messages would be received at any of their stations in the United Kingdom for the Cape. The retiring auditors were re-elected, and £10 awarded to each for their services.

The Electric Telegraph and the Railway System.—It was stated that 27 per cent. of the accidents in England were due to the want of the telegraph. As all the Indian railways had telegraphs, this per centage might be assumed to be erased from their quota of casualties. It would appear from the parliamentary returns, that out of 4,225,240 passengers carried in India during the year 1860, none had been killed from causes beyond their own control, while 94 per million only were injured. On comparing this with the English returns, it appeared that out of an annual average of 139,000,000 passengers carried, 15 per million were killed, while 319 were injured. According to the returns for 1862 the passengers carried were 173,721,238, while the number killed were 26 per million, and 450 per million received injury. It also appears that one-half of the accidents on the English lines arose from collisions, while on the Indian railroads one-seventh only emanated from the same cause. This proved that collisions which might be looked upon as preventible accidents, to a certain extent, were less frequent in India, and necessarily so, owing to the aid afforded by the electric telegraph in regulating the traffic.

The Atlantic Telegraph.—The failures of science, to paraphrase an old proverb, are the renewal of scientific endeavour. When the electric cable between Great Britain and America was *not* laid, the certainty that it must be laid, at some period more or less remote, was then apparent to all who have any faith in human energy and human skill. Every disaster in the course of that great experiment of 1858 was a priceless lesson to the men of thought and enterprise who seek to achieve the same magnificent project in 1864. They recommence their task with an improved knowledge of its conditions and its difficulties; and a comparison of the old and the new cable will show that this knowledge has not been acquired in vain. Mr. Cyrus Field, who has crossed the Atlantic Ocean thirty-one times in the service of the company by whom the vast undertaking is to be carried out, has perfect confidence in the efficiency of all the plans; and even an unscientific observer must be impressed with the fact that all the grave objections to preceding modes of operation have been practically met, and, to all appearance, overcome. On the 28th instant a large party of gentlemen, who regard with peculiar interest the proceedings of the Atlantic Telegraph Company, met at the Gutta-Percha Works in Wharf-road, City-road, and witnessed every separate process of manufacturing and testing the cable. There were present, among many others of note, the Marquis of Tweeddale, Mr. Bright, M.P., the Hon. W. M. Evarts, Mr. Percy Salmon, Mr. Saward, Captain Hamilton, Mr. Glass, Mr. Varley, Mr. Edwards, and Professor Wheatstone. The electrical tests incidental to the operations of isolating the wire were conducted with great nicety, and with admirable effect. Fusees were fired by means of a current despatched through sixty miles of the coated wire, and various pretty results were shown, such as would have made the dullest lecture attractive to the least scientific hearer. One young gentleman of an ingenious countenance and an inquiring spirit manifested an obliging readiness in touching a spring which communicated with a

battery, so as to discharge the explosive compound at the farther end of the wire. The manufacture of the cable differed at almost every step from the process adopted six years ago. It is nearly twice the size to begin with, and the weight of the copper strand which forms the conductor is considerably more than doubled, the number of pounds avoirdupois to the nautical mile being 300 to 107. The insulation is rendered perfect by means of a new adhesive material—Chatterton's compound—with which the copper strand is first coated, and which alternates with the successive layers of gutta percha, binding them firmly together, and effectually excluding air. A transverse section of the wire and its fourfold skin exhibits the dark rings of the cementing compound, and, so far as isolating protection is concerned, justifies an implicit belief. But protection against rough external influences is also needed, and still more requisite is the strength of resistance which provides against an enormous tension. In place, then, of the eighteen strands of charcoal-iron wire laid spirally round the core, with a padding of tar-saturated hemp between, we have now ten solid wires of homogeneous iron, each wire surrounded separately with five strands of Manilla yarn, saturated with a preservative compound, and the whole laid spirally around the core, which latter is padded with ordinary hemp, steeped with preservative mixture. The breaking strain of the old cable was 3 tons 5 cwt.; while in the present case it is 7 tons 15 cwt. So much for the increased strength of the coil; and in other essential respects great improvement has been attained. The splicing is now managed with a certainty which insures not only a greater power of resistance in the joints than in any other part, but also an equal electrical strength throughout. The contract with Messrs. Glass, Elliot, & Co., for the manufacture of this cable extends, we believe, to the laying it down; and the accomplishment of their immense work may be looked forward to with as much hope as anxiety.—*Daily Telegraph.*

MISCELLANEA.

This is the age of inventions; Mr. Barker, our countryman, to whom the organ owes the lightening of the touch of its key-board by aid of the pneumatic lever, now associated with M. Verschneider, having been commissioned to build an organ for the church of Augustin, at Paris, intends to introduce there another new device, in which by aid of electricity the communication of key with pipe, at present a cumbrous and complicated piece of business, is replaced by something simpler.

Freaks of Lightning.—In a house at Felzius, near Figeal, struck with lightning, the flooring of the upper story was turned upside down, and all the nails disappeared; all the locks and bolts were destroyed, and there remains nothing of the lock-press, which was in one of the rooms. The owner of the house was in the act of unlocking the outside door at the time, and the key in his hand was cut in two by the lightning without causing him any injury.

Seeing the Elephant.—Some years ago there was a joke passing around upon the different telegraph lines, which was played off upon a good many unsuspecting individuals in the following manner:—"Boston, April 1st, 1855.—To L. E. Phant, at some Hotel, New Bedford: In leaving this morning, you neglected to take your trunk. What shall be done with it?—Adam Goodsell." By pronouncing the name of the party addressed quickly, and the signature slowly, a solution of the "sell" is obtained, and you get a view of the elephant at the same time.—*Prescott.*

How to Begin.—Too many are, however, impatient of results; they are not satisfied to begin where their fathers did, but where they left off; they think to enjoy the fruits of industry without working for them; they cannot wait for the results of labour and application, but forestall them by too early indulgence. A worthy Scotch couple, when asked how their son had broken down so early in life, gave the following explanation:—"When we began life together we worked hard, and lived upon porridge and such like, gradually adding to our comforts as our means improved, until we were able at length to dine off a bit of roast meat, and sometimes a boilt chuckie (or fowl); but as for Jock, our son, he began where we had left off—*he began with chuckie first.*" The same illustration will apply to higher conditions of life than that of this humble pair.

The Earth.—M. Gavarret gives the following explanation of the manner in which the earth acts when forming part of a circuit:—"The poles of a battery, when disconnected, have equal and contrary tensions. When insulated conductors are placed in contact with them, they themselves become the poles of the battery, the battery having furnished a current sufficient to charge them, but not of sufficient duration to move a galvanometer needle. If the conductors are enlarged, the time occupied in charging them will increase, until, as they are still further enlarged, a limit will be reached at which the flow of electricity into them will last long enough to affect the galvanometer; and when the conductors become infinitely long or infinitely large, the time occupied in charging them also becomes infinite; or, in other words, the current will pass precisely as if the poles were connected. Thus, when the extremities of a circuit are connected to the earth, which is an infinitely large conductor, their respective tensions are diffused in all directions, without producing any appreciable tension in the earth itself, so that the current will continue to flow.—*Télégraphie Electrique.*

Atmospheric Electricity.—There is always free electricity in the air and in the clouds, acting by induction upon the earth and the wires, and creating an opposite tension in them. If the electrical state of the atmosphere were constant, that of the wires would remain constant also, as far as regarded their mutual influence. But it is not so. When an electrified cloud approaches the wires, it causes currents in them which escape in sparks at the apparatus, demagnetising or reversing the magnets or fusing the coils, even although there may be no actual lightning. No case has, however, occurred in which the person in charge of the apparatus has been injured, for the instrument affords the current a much more ready path than that given by the human body. Tying a knot in the fine wire of a coil will often cause the spark to jump to the metal frame, and thus preserve the coil from destruction. During a storm the instruments should be placed on short circuit, by connecting their terminals across; and, if the lightning be very vivid, it may be best to disconnect them, putting the line direct to earth. In situations much exposed to lightning, some form of paratonnere or protector should be used, especially at the end of long pieces of underground work or cables. But they must always be placed indoors, or it will be impossible to preserve their insulation. As long magnets retain their power much better than short ones, it is desirable not to use very short needles in signal instruments, where reversals might be dangerous.—*R. S. Culley's Hand-book of Practical Telegraphy.*

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.
Good re-boiled	1/6 to 1/8 „

India Rubber.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/5 „

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	99 to 102	—
100	Submarine Telegraph, scrip. .	all	48 to 53	—
all	Do. registered	all	$\frac{5}{8}$ to $\frac{3}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

Several valuable communications are unavoidably postponed.

C. K.—We have not much sympathy with the opinions of a gentleman whose intolerance of rising merit has become proverbial.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

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BONELLI'S TELEGRAPH.

In our last number reference was made to a challenge on the part of the United Kingdom Telegraph Company to the Bonelli Telegraph Company, to test the relative merits of the Hughes and Bonelli's systems of telegraphy. Having been informed that the trial was to take place on the 30th of April, we, at some inconvenience and trouble, went down to Liverpool to witness the competition. On our arrival we, however, found that the United Kingdom Telegraph Company had, for reasons which will be found in another part of this journal, declined the contest. Several experiments were, nevertheless, made with the Bonelli instrument on that day and the following Monday, with the results hereafter described. The Bonelli Company have for some time, as our readers are aware, carried on an extensive and increasing business between Liverpool and Manchester, and have recently determined to greatly extend their operations, and with that view have applied for additional capital, which we believe has now been secured. The Company in the first instance will proceed to construct a line between London and Glasgow. Having no interest in either Company more than that of public journalists, we shall endeavour to place before our readers the facts as they presented themselves to us, avoiding technical expressions or scientific terms, which have unfortunately rendered the science of telegraphy unintelligible but to a few.

Although we have before described in our columns the construction and action of Chevalier Bonelli's instrument, for the benefit of recent subscribers we shall place before them again a short description thereof.

Let the reader suppose himself to be the operator: before him he will find an oak table, 7 feet in length, 17 to 18 inches wide; along the centre of this table runs a miniature railway, terminated at either end by a spring buffer, and spanned midway by a kind of bridge, 6 inches in height, and 2½ or 3 inches wide. Upon this railway is placed a species of waggon, 3 feet long and 5 inches wide, 3½ inches in height, running upon four brass wheels; on the surface of this waggon are two long rectilinear openings—the one occupying the upper half, and destined to carry the message which is to be sent, the other occupying the lower half, and intended for the message, which may be to be received; upon the bridge are two small metal combs, each containing a number of insulated teeth, answering in number to, and connected with, the insulated conductors of which the line is formed. The combs differ from one another—the one which is to despatch the message being formed of so many teeth, having a certain freedom of action, is on the side of the bridge farthest from the operator; the other, or writing comb, is formed of a similar number of teeth fixed in a block of ivory, and forms a perfect line, which rests with a slight but regular pressure transversely on the paper, and occupies the nearer portion of the said bridge. We will suppose that the tables have been tested, and that a number of messages are to be despatched; these messages are distributed to a given number of compositors, who set them up in ordinary type with great rapidity, and handed to the operator, whose waggon has already been pushed to the upper end of the rail, and is held there by a simple catch; he places this dispatch in the opening destined for it, and in the second opening he places a plate of metal, upon which has been laid thirty or forty strips of paper prepared with a solution of nitrate of manganese; this done, he turns a small handle and watches; if the operator at the other end has done his work, the waggon is at once freed from the catch, and is set in motion by a simple weight, the pace being regulated by a fan; the type of which we have spoken is thus brought under the action of the despatching comb, and runs lightly under its teeth from end to end; one half of the journey being made, the writing comb comes in contact with the prepared paper. If the operator at the other end has had a message to send it will have been printed in clear, legible characters, of a deep brown colour, answering with unerring fidelity to the forms over which the corresponding type comb has passed, while the operator (the reader) learns that *his* message has as surely been received; the message is stripped off, the waggon remounted, the type box changed, and the process of transmission and reception repeated.

On the day appointed for the competitive trial we attended at the Company's office in Dale-street, Liverpool. There were present the Mayor of the town, several other gentlemen, and the representatives of the press. The Company stopped the general traffic at one o'clock, when the experiments commenced.

Upon testing the line wires for insulation or loss of current with one of Mr. W. T. Henley's galvanometers and an ordinary sulphate battery of 48 elements, we found that the leakage or loss on each was as follows:—On No. 1 wire, 55°; on No. 2 wire 35°; on No. 3 wire, 40°; on No. 4 wire, 10°; on No. 5 wire, 55°. Although the state of insulation on the wires varied, especially in the case of No. 4 wire, we could not detect any difference in the strength of the current from its action on the prepared paper—the decomposition as indicated by the colour was as complete on the *point* of No. 5 wire as it was on that of No. 4. This is an important feature in the working of this ingenious instrument, and from which we may infer that distance or heavy leakages have not the same disadvantageous effects upon the decomposing powers of a current, as they have upon its directive and magnetising properties, upon one or other of which, with a few exceptions, depends the action of every instrument hitherto introduced.

We have given above the measurements of the leakage on the wires before commencing the experiments; the following are the measurements, taken with the same instruments and the same battery power immediately on the completion of the experiments:—No. 1 wire, 15°, No. 2 wire, 0°, No. 3 wire, 0°, No. 4 wire, 7°, No. 5 wire, 45°. Yet with this superior insulation we could not find any marked difference in the impressions of the metallic points on the prepared paper. The five wires appeared to have conveyed the same amount of decomposing or printing power.

The instruments employed on the occasion had been in daily operation for some months. In the time-tests the first message or matter was sent at 11 minutes to 2 o'clock p.m., and the last at 2 minutes to 2 o'clock, p.m. The number of messages sent and received between Liverpool and London, in nine minutes, being 80, containing on an average from 20 to 22 words, or altogether of from 1,600 to 1,760 words, consisting of some 8,800 letters, in the whole of which there was not a single error. A far greater amount of matter could have been sent had it not been for the absence, through severe illness, of the clerk who has had the management of the instrument. We found that the five young ladies employed were greatly in advance of the instrument with their type-sticks, or rulers, owing to the absence of

the regular manipulator from the Liverpool station, as above mentioned.

On the following Monday we again attended at the Company's offices, in Manchester, it having rained heavily the previous day and night. On that morning we witnessed the transmission of numerous messages to and from Manchester, with the same satisfactory result as on Saturday, which was a dry and sunny day; in fact we found that the letters were more distinctly rendered under circumstances which have a contrary effect on the operations of instruments depending upon the action of the electro-magnet, and not upon the decomposing powers of the current.

Nothing could be more satisfactory than the operations carried on in our presence, and we believe that the instrument, not only from the wonderful rapidity with which communication is effected by its means, but from the correctness of its action and its non-liability to get out of order, will prove the most valuable hitherto introduced; and after the opportunity afforded us to witness the apparatus in full operations, over a distance of 46 miles, of which 8 miles are underground wires, we feel certain that the expense of the five wires necessary is vastly more than compensated by the immense quantity of work which it is capable of accomplishing.

We witnessed with admiration the rapidity with which the five fair compositors performed their respective duties; the time occupied in setting the type for messages of from 20 to 25 words seldom exceeding 85 seconds, and this with the capability of the instrument to transmit the messages at the rate of 50 words, or 250 letters, per 10 seconds, does not certainly indicate that either commercial or mechanical impracticability will ever militate against the extensive employment of the instrument for telegraphic purposes.

One of the great advantages possessed by the Bonelli instrument is that the message can be repeated to any extent when once the type is set, and that it can be sent to any number of towns by an ingenious system of shunting; for instance, a message of say twenty words is printed at Manchester, instantly upon its completion the five wires are united by switches to the five wires leading thence to the Liverpool, York, or Glasgow instrument, when the message is reproduced without the necessity of the re-setting the type at any intermediate station. As a further illustration of the advantages which such a system of telegraphing affords, let us suppose that an important speech is being delivered at the House of Commons, or elsewhere, a transcript of the short-hand notes is delivered to the compositors, the matter is placed in the machine, and at the distant towns duplicate copies can be produced in "print" and sent to as many papers as there might be published in those towns, at the rate of 200 words per minute, as effected in our presence.

THE DOMESTIC TELEGRAPH.

THE following useful and amusing article was recently contributed to *Chambers's Journal* by a gentleman well known in the telegraphic world, and needs no further introduction to our columns:—

If any person in the present day were to announce that he purposed making use of a gravity-pump, to pump weight out of himself, and then to project himself, for a few days' shooting, into Africa, he would probably be regarded, by even enthusiasts, as an insane individual. If, however, any person living in 1763 had given notice that he purposed employing a small portion of lightning to carry a message for him from England to Russia, he also would then have been looked upon as a no less deluded maniac.

It is an interesting, and, at the same time, an instructive study, to watch how the impossible gradually become the probable, the probable the actual, and, soon after, a thing that everybody knows. When we become familiarised with any great or important discovery, and with its application to every-day life, we soon forget, or rarely reflect upon the trials and difficulties that truth has invariably to encounter before it takes its place in its new phase as one of the facts of the day.

Even in the present day, when steam and electricity, glass and gunpowder, and many other useful agents are familiar to us all, there are not many amongst us, who, if suddenly transplanted to a colony, or amongst people who were utterly unacquainted with these things, could either clearly explain matters connected with them, or instruct others how to use them.

Steam and its applications are not nearly so mysterious to the public generally, however, as is electricity in all its branches. Even to those who have studied the subject all their lives, electricity is still a mystery. We live in an epoch of names, and when we have applied a term to anything we seem to have described its meanings or attributes; but we are as far as ever from a real knowledge of this force or power, when we state it is called electricity, from *electron*, a Greek word signifying amber, and is produced in various ways, friction being one.

In order, however, to be fully aware how many persons there are who still remain unacquainted with even the simple application of electricity, it is necessary to be in a measure behind the scenes, in which position we ourselves have had the advantage of hearing very many amusing incidents.

It is not by any means uncommon to find that, some parcel being required in a hurry, a frantic individual rushes into a telegraph-office, and requests that his parcel may be sent by telegraph immediately. Within the last few days, a gentleman seriously requested a telegraph-clerk to send two dozen stamps to his wife in the country, the stamps being offered and folded up in readiness for transmission. Another person being desirous of sending an anonymous message to a friend, refused to write his message on the paper, because, should he do so, his friend would of course recognise the handwriting. Not long since, we heard a facetious young gentleman inform two or three individuals that the Americans had lately discovered so rapid a means of photographing as to enable them to photograph the messages as they went along the wire. The information was not only seriously received, but one of the hearers stated that he had read something about it in the papers, and it was called "Topping the Telegraph."

When any little incidents of this nature happen, it is not unusual to attribute them to "old ladies;" but, with one or two exceptions, the most amusing misunderstandings have occurred, not with ancient dames, but with gentlemen in the full bloom of health, and not past the middle age.

One of the many singular facts that are brought to light by the telegraph is, that certain types of minds instinctively connect haste with danger or disaster. It was not many years ago that it was considered dangerous to travel from York to London under two days. The telegraph, then, which is a very hurrying sort of affair, would, we can easily imagine, create a certain amount of alarm from its speed alone; but, in addition to this, it was, when first used, a very expensive way of sending intelligence, and employed therefore only in extreme cases. Hence the public, to a certain extent, have been trained to connect a telegraphic message with sudden illness, accidents, want of a doctor, fires, or some disaster; and, to those whose lives jog on in a slow every-day style, a telegraphic message is so unusual an event, that they are probably correct when they connect a telegraphic message with alarming news. Though the establishment of a London district-telegraph has to some extent done away with these ideas, there yet lingers a large remnant of this alarm, which crops out on many occasions.

Not long since, the District Telegraph Company considered it advisable to send out a few circulars informing the public that the could now procure one hundred of their stamps for one pound; that a stamp placed on a written message, which might be enclosed in an envelope and sent to the nearest station, would ensure the transmission of their message: thus, that the actual price of a message of fifteen words is rather under twopence-halfpenny. This information was received by many people with pleasure, as they found they could now send their messages at a very economical rate, but others did not accept the information with the same feelings. One gentleman, upon the receipt of the circular, immediately communicated to the company, and remonstrated with them. It appeared that he had a near relation seriously ill, about whom he was very anxious. Upon the receipt of the circular, on the envelope of which was printed "Telegraph Company,"

he was greatly alarmed: so much so, in fact, that he had not been well for several days afterwards, as he of course imagined that his friend must be dead, in consequence of his receiving something from a telegraph-office. It was suggested to this alarmist that the message might have been to announce that his friend was better; but he adhered to the old proverb that only "ill news flies apace," and that the company ought not to have caused him groundless alarm.

This feeling of alarm is very widely spread, in spite of the frequency of domestic messages. For example, a gentleman having met an old friend in London, telegraphed to his faithful spouse to the effect that he should bring this friend home to dinner at six. This simple announcement he believed would be a sufficient hint that something extra should be provided. Alas! there was nothing besides the usual family dinner; the fatted calf had not been slain.

"Why, my dear, did you not receive my telegram, saying that I was going to bring him home to dinner?"

"Thank Heaven, my dear," replied his wife, "my alarm is over. I did receive a dreadful telegraph; but I was so frightened I dared not open it, and there it is on the mantel-piece. I thought you must be killed, or run over, or something, and I've been more dead than alive ever since."

These, and several other similar instances, come almost weekly under the notice of those officially connected with this much-dreaded but very useful power. The district-telegraph is decidedly the most domestic of its class; the fact that it is principally established for the purpose of conveying messages twelve miles round London, enables men of business in town to communicate easily with their families, and their families with them; and should these parties be within a reasonable distance of an office, the cost of the message will be at most sixpence, and if stamps are used, only twopence-halfpenny.

We will now trace the course of a telegraphic message, from its first production at the hands of the sender, to its final delivery to the receiver.

First, we must offer a few remarks upon the selection and omission of words in a message—fifteen words, excluding address, are allowed; and it is of course desirable to convey as much information as is possible in these fifteen words. A person not accustomed to send messages should first write down what he means to say, and then recast his sentence so that he may express the same sense in fewer words. Here, for example, is a message that a friend once sent to us: "Will you meet us to-night at eight o'clock at the chief entrance of the Lyceum; we have front seats in the boxes for four." Here were twenty-five words used to convey an intimation which might have been done in fourteen, for the message, as follows, contains the same sense: "Please meet us at eight, chief entrance Lyceum, we have four front-box seats."

In a telegraph message, a certain amount is left to the common-sense of the receiver—as in the above; no sensible person would go to the Lyceum at 8 A.M. in order to witness a performance; the "to-night" is likewise unnecessary, for unless it had been "to-night," a telegraphic message would have been out of place: and so in many other cases brevity may be adopted with advantage. The writing cannot be too plain and distinct, a school-boy sort of hand being preferable. There are some ever-recurring mistakes in connection with the art of telegraphing, quite independent of mistakes from bad writing, so that it is a sender's interest to make his part of the performance as intelligible as possible.

As soon as a message is written and given to a clerk, the document is read over and placed in front of an instrument. The clerk then "calls" a station, usually that at Cannon-street; and this calling consists of some special movement of the needles, which is always the same for the same station; upon the called station answering, the message is commenced. Each letter composing the words is indicated by a particular series of movements of the needles, which movements are caused by an electric current sent from the first station. This current of electricity is the result of a movement of two handles made at the instrument by the clerk. The current traverses the wire instantaneously; and as it passes through a portion of wire at the other station, it converts this into a powerful temporary magnet, which therefore attracts the needle temporarily, each movement of the handle at the first station causing a movement in the needle of the second. Now, it is by these movements of the needles that the clerks read off the messages; so that the fears of the gentleman who did not wish his handwriting to be recognised by his friend to whom he telegraphed, were groundless, his words being converted into a fluid state, and again reconstructed in the ink-and-paper form at the other end of the wire.

Should the message be from one out-station to another, the clerk at Cannon-street copies the message, and delivers it into the hands of the person who works the particular instrument to which the office for which the message is intended is connected. The clerk there again copies the message, and delivers it to a boy, who carries it to its final destination. A copy of this message is retained at Cannon-street for about three or four months, after which it is destroyed.

The clerks employed at this work are almost all females, there being upwards of one hundred and twenty young girls obtaining a livelihood as telegraph clerks. They receive, on an average, about ten shillings per week; and, as the whole of their time is rarely employed in telegraphing, they are enabled, in addition, to use their own needles, whilst in readiness to read the needles of the telegraph instrument. The hours of work are from 9 o'clock A.M. to 7 o'clock P.M., a tolerably long spell, supposing they were employed all the time in reading the vagaries of the magnetic needle, or in sending messages; but, as intervals of rest are of frequent occurrence, the labour is comparatively light, and of a more attractive kind than mere sewing for a living.

It might be imagined that when messages of all classes are being sent by the aid of a number of young girls, that there was very little chance of a message being private or not divulged, but there are one or two reasons why the public are very sufficiently protected in this respect. In the first place, a telegraph-clerk becomes a kind of automaton; and, in consequence of day after day sending off some half-dozen score of messages, no particular one is likely to impress itself on the memory and be there retained. In addition to this natural cause, it is a part of the service agreement that no clerk divulges the purport of any message; and an act of parliament was passed during last session, rendering any person liable to a penalty of twenty pounds who delayed or divulged a telegraphic message. Thus, in this respect, the public are well protected.

There are now two systems of communicating in almost general use; the first is by the aid of a single needle, the Morse alphabet being in almost universal use. This enables a clerk, independent of his nationality or knowledge of language, to read off the letters from his instruments, so that an English clerk in London might send an English message to Russia, which would be read off by a Russian, and written in English. In like manner, an English girl would be able to read off a message sent in the Russian language, with the same ease that she could one in English. Thus there is a universal language in telegraphing as there is in music.

The other method of communicating is by printing, the various letters being indicated by a series of dots and dashes. From the time of first commencing to study the instrument until proficiency is obtained in reading and sending, two months usually elapse—shorter or longer, according to the talent of the clerk. A clerk is generally able to send a message before she can read one; it is also found much more easy to read the messages sent by one clerk than those by another.

At the present time there are about two hundred and fifty miles of wire, set up on the housetops and underground, for the use of the London and twelve-miles-round telegraph; by the aid of these and the eighty-three stations now open, it would be possible to send about one thousand messages per hour—a quantity sufficient to render the district telegraph a very paying investment. At the present time, however, the number per day, on an average throughout the year, does not exceed one thousand, so that only one-tenth of the work that might be done is actually accomplished.

Some curious statistics are brought to our notice when we examine the causes that influence the number of telegraphic messages. A very fine morning, followed by continued rain from mid-day, is at once a source of business to the telegraph company. Numberless appointments that had been agreed on when the weather was fine have to be put off. Gentlemen who purposed walking home from the station would now prefer their brougham, or their waterproofs, or something to protect them from the weather. The friend who was coming to dine with them will select another day, and this naturally leads to a second message from the disappointed host to his faithful spouse. A very wet morning sometimes causes several extra messages, for the prudent will, at the last moment, sometimes change their raiment in order that they may have nothing on that will spoil, and their keys, unfortunately, are left in those garments

which had been cast off, so that a message is sent to have the keys forwarded by next train.

It is in messages of this kind where the electric telegraph is of immense use, and where any delay at once produces serious inconvenience. It would be of little use to a business-man to have his keys forwarded by a three P.M. train, when he wished for them by one arriving at eleven A.M., and yet, perhaps, half-an-hour's delay on the part of a clerk, or the boy who delivered the message, might produce nearly as great a difference as this on lines where only a few trains run.

When, again, any information has been forgotten, and is required immediately, this district telegraph is very serviceable. On one occasion we went to London, and had an engagement somewhere near Holborn, but the actual address we had left on our dining-room mantel-piece. Telegraphing from London-bridge, we directed the message to be sent to the office at Charing-cross, and we then proceeded by boat to Hungerford. Upon reaching Charing-cross we entered the telegraph-office, and, on inquiring, were presented with the message just arrived, and containing the name of the locality where we were to keep our appointment.

The greatest number of messages ever sent in one day by the London district telegraphs was on the day previous to the Princess of Wales entering London, no less than 1,500 having been received and sent on that occasion; the principal purport of these messages was the engaging of seats and friends, the announcement of disappointments or of expectations—in fact, an endless variety of anxious, eager lines, all with reference to the event of the morrow. On all great public occasions work is brought in to the telegraph, so that the meeting of Parliament, the Derby-day, &c., are days of extra work.

In an upstairs room of the office in Cannon-street there is a kind of cupboard, upon opening the doors of which a mass of wires and screws, bolts and fastenings, are exposed to view; these are all lettered or numbered, and a strange mystery exists with regard to them; they are really the junctions between various station-wires, and thus two extreme stations might at once be placed in connection with each other. We will suppose that B represents the termination of the wires that lead from Blackheath to Cannon-street, by which wires the messages are sent, and C the termination of the Camden-town wires. Now, B and C might be a yard apart in the cupboard, and it would merely be necessary to join these two by means of a wire, in order to allow Camden-town to talk to Blackheath, or *vice versâ*.

A wonderful medley of messages might be read by any curious individual who placed an instrument in any circuit, as it is called, for his needle would move in accordance with the needle at the end of the wire, and thus the message would be read off.

Some singular and amusing mistakes sometimes occur in connection with telegraphing, in consequence of the misreading of a word or letter—the signals for some few words being very similar—that is, the movements of the needles to indicate one word are very like those which indicate another with a very different meaning. A household in the country were rather surprised at receiving a message from the lord and master to the effect that he wanted his wig to be at the London-bridge station by four o'clock P.M. As the gentleman had a very excellent crop of natural hair, of course the family were somewhat perplexed; for "wig" read "wife," and the message was intelligible. A gentleman telegraphs to his friend to the following effect: "I want you to get me this evening at any place you may appoint;" for "get" read "meet." A cautious spouse sent a message to his wife, who received the following: "I am going to bring some hog home for dinner to-night—be ready." The wife, probably expecting a large piece of pork, did not prepare much for dinner, and is consequently very much surprised when her husband returns, and brings with him a very old friend, who is very unlike a "hog." The words "hog" and "one" were unluckily very much alike, and were mistaken the one for the other—"Bring some one home for dinner" was very intelligible.

Considering the number of messages per diem, and the imperfect manner in which addresses are often given, and the badness of the senders' writing, there are remarkably few mistakes.

Occasionally, when the wires are very close together, the rain will bring two wires into contact; then the messages which ought to go in one direction run away with the words, and deliver them in quite another place. Thus, a short time ago some large tea agents were much puzzled by receiving perpetual inquiries about cargoes of beef: "How about the beef?" was an oft-repeated question. Some shipping agents, whose private wires ran down the same line, were equally puzzled at having repeated demands for another chest of unmixed tea. It was very shortly found that the wires had been brought into contact by wind and rain, and thus the message for one firm had flown off at a tangent, and had made its way in a wrong direction.

It is not at all an unusual circumstance to find that certain unscrupulous persons are on the watch to obtain money from telegraph companies, on the plea of losses sustained in consequence of mistakes. Such an attempt was made a short time since. A gentleman having sent a message up to his office in London, saying that he was not well enough to attend business on that day, omitted in his address to say that there were two streets of the same name close together. The boy who had to deliver the message went to the wrong street, and upon looking for the house indicated by the number on the telegraph direction, found that the house was in ruins, and men at work amongst the débris. Having given the information at his office that the house was in ruins, the intimation was forwarded to the sender of the message that, the house being in ruins, the message could not be delivered. Here, then, was a real grievance—a decided case for compensation—for the gentleman, upon hearing the alarming intelligence that his town-house was in ruins, was taken so seriously ill, that it was at first feared he would not recover. A messenger was immediately despatched to London to inquire into the cause of the house being in ruins. Thus, much expense was incurred, and serious loss in consequence of the illness produced by alarm; and therefore the District Telegraph Company ought to fully compensate the gentleman, or he would be compelled, however much against his feelings, &c., &c. But such little matters had been tried on before by other injured individuals, and the gentleman did not receive any pecuniary recompense.

Lightning sometimes produces a temporary stoppage in telegraphing, as the natural electric fluid demagnetises the needles, and therefore renders them temporarily useless. During the severe storm in September, 1863, no less than fifteen stations belonging to the London District Company were rendered temporarily useless by the lightning. In no instance have we ever heard of a clerk being damaged by the electric fluid, although in one case a clerk received a shock. He happened to be standing on a damp floor, and was holding the handles of the instrument very firmly; a storm passing over his circuit gave him a slight shock, which, however, did little more than alarm him.

It is not an uncommon thing to hear of birds being killed by the wires of an electric telegraph, and people unacquainted with the principle of telegraphs not unfrequently imagine that it is the electricity that kills them; this, however, is not the case. If a bird were to become very wet, were then to hold on to the wires with its feet, and stick its beak into the ground, it would then probably receive a slight shock, but birds are not naturally given to practise this experiment. The way by which birds become killed is by flying against the wires by night, and thus striking themselves, become either killed or seriously damaged. So frequently does this occur, that in one large game district a gentleman preferred laying down wires in another place at his own expense, rather than have them going over his land near his preserves.

One of the many advantages derived from our familiarity with the telegraph is the arrangement of all the clocks on railways and in London to Greenwich mean time. When the ball drops at one o'clock at Greenwich, a signal is sent to Cannon-street, and the clock there being thus regulated for Greenwich time, a signal can be sent to all out-stations, or to any private establishments where a knowledge of correct time is of importance.

The majority of our readers have probably heard the singularly melancholy noise that is sometimes made by the wind blowing against the wires that are suspended against the telegraph-posts. It has been asserted by some individuals that when the noise is greatest, rain is sure to fall very shortly; but as the quantity of the noise must in a great measure depend on the direction and strength of the wind, we are bound to deny the accuracy of this assertion as a general rule.

We before mentioned that the majority of persons were not well acquainted with either the principles or practice of telegraphing, and that hence some very amusing mistakes sometimes occurred. We will conclude this article with one, for the accuracy of which we can vouch.

An old lady (this time) had given permission for some wires to be placed on her house, where they were supported by a ... After these had been in position some few weeks, the old lady ...

waited upon the principal telegraph authority, and stated that she had a complaint to make. "The fact is, sir," she said, "them telegraph messages won't allow me to get any sleep of a night; I lays awake, a-tossing about, and can't get a wink for the noise. At first, sir, I didn't mind it as much, and things were not as bad as they are now; but lately, sir, there have been a deal more messages. I don't think either, sir, that you are aware of all that's said along them wires; there's much that hadn't ought to be; for I can assure you, sir, that very much that's said there—and I have to lay and listen to—no respectable woman ought to hear. So I've come at last to complain to you, sir, hoping that it may be stopped."

The gentleman to whom this singular complaint was made was, of course, aware that the noise complained of was the wind in the wires; the messages of a doubtful character were the emanations of a fruitful imagination on the part of the old lady. He, however, pacified her by stating that in future young women of great respectability were to be substituted at the offices for the young men who formerly worked there, after which he received no additional complaints from the wakeful and imaginative old dame.

THE TELEGRAPH IN SPAIN.

WE have much pleasure in laying before our readers two interesting documents connected with the telegraphic establishment of Spain, which have been forwarded to us for publication.

The following important decree has just been issued by the Spanish Government respecting telegraphs and their extension without burden to the State, which we lay before the readers of this Journal, not only to show the views entertained in that country upon this important subject, but to acquaint the different English telegraph companies of matters concerning telegraphy, which cannot fail to be of interest. The young Minister of State for Home Affairs in Spain, His Excellency M. Antonio Cánovas del Castillo (who does honour to the province of his birth, Malaga—truthful example of the Andalusian youth), gives every day practical proofs of administrative capacity, and justifies the high reputation he enjoys, as a jurisconsult and as an economist, by the interest he takes in opening up means of communication, clearly seeing it to be, as it is, the first necessity of the times, and one of the best and most efficacious auxiliaries for the development of commerce,—the foundation of the prosperity of nations.

MINISTRY OF STATE FOR HOME AFFAIRS.

Exposition to Her Majesty.

Madam,—The petitions presented to your Majesty from different towns, various companies, and private individuals are so numerous and repeated, praying your Majesty that the advantages derived from telegraphic communications should be granted to them, that the minister, who now humbly addresses your Majesty has lamented more than once that the care of the government has not extended that satisfaction to legitimate wishes, so deserving of attention, which are so intimately connected with the duties of the administration, in respect to the disposal of the resources at its command, as well as the rights of society, inasmuch as they answer to that end without endangering public interests.

Having respect to the unchangeable principle, that state necessities alone must be borne by treasury funds, and the proper and regulated use of the telegraph being guaranteed, subject to those conditions which now regulate correspondence, not only is the amplitude proposed to be given to this service, free from inconveniences, but must produce most remarkable and advantageous results, as is clearly indicated by the repeated and general applications from localities as yet deprived of its benefits.

To answer to this wish in a satisfactory manner, the minister, who now humbly addresses your Majesty, thinks that it will only be required to bear in mind two equitable conditions,—First, that the services of local and private interest should be defrayed by those who require and profit by them; and, second, that bound up as they must be with the general working, they cannot in any way cause the least interruption in this, neither by its material conditions, nor in the tenor of the correspondence. These two indispensable conditions being adopted, as they are by the annexed project, there does not appear the least danger or difficulty in granting this concession, for an unlimited extension to the telegraphic lines, so much desired by towns, companies, and even by private individuals, a measure imperatively demanded by the necessities and requirements of daily occurrence, which constitute the only rule to fix the extension and nature of the new service; and this will be realized, at the same time diminishing the burden imposed at present upon the treasury by this important branch, placing it upon a better footing to fulfil its mission, thanks to the increase of lines, without imposing on districts or private individuals more expenses than those incurred in working them, and accepted with previous knowledge and free will; all this to be under equitable regulations, which will not admit of question.

If this suggestion should merit your Majesty's good pleasure, would your Majesty deign to sanction the annexed proposed decree.

(Signed) ANTONIO CANOVAS DEL CASTILLO.

Madrid, March 30, 1864.

ROYAL DECREE.

In conformity with what the Minister of State for Home Affairs has proposed to me, upon organising the concession of lines and telegraphic stations,

I have decreed as follows:—

Art. 1. The districts, towns, companies, and public establishments who wish to form new lines or stations, can solicit them from the government, pointing out the daily working hours which they desire. The government will enquire into the influence of the establishment of the said lines or stations upon the state telegraphic system, and will fix the point or points at which it must be joined with the provincial, municipal, or private service, its cost of installation, and the continuous expenses of staff and material, in all respects which that service may occasion, either directly or indirectly by its influence on the general organization.

Art 2. The necessary cost of installation and service of the lines or stations will be communicated to the petitioners when ascertained by the government, and the petitioner will have to declare if he is prepared to pay the amount to the state. In case he should be ready, the government will fix the scientific staff for the establishment, which will be carried out, either by the administration, or by the parties interested in it, at their choice and expense; and they will have also to give sufficient guarantee for cost of repairs and service; and if the petitioners represent a province or a town, they will have to be inserted in the provincial or municipal budget as obligatory. If the interested parties should undertake to form the plan, it will be carried out in accordance with the fixed rules for telegraphic lines established by contract.

Art. 3. The petitioner will be obliged to pay to the state the difference that may result between the annual income from the correspondence carried through the stations granted, and the cost of the service, and keeping up the same; also that of the reforms demanded by the necessity of the case in stations or lines previously established. The official correspondence will be reckoned as private, and its amount will be credited to the stations to which it corresponds.

Art. 4. If at the expiration of five years the expenses exceed the returns, the line or station, wherein so happens, will be considered as property of the state, and the government will proceed with the reimbursement of the expenses to the locality which has had the line. This is not applicable to the case of companies or establishments, public or private, which have given guarantees of permanent profits.

Art. 5. No line or station can be formed in future without being previously taken in consideration by the ministers in council as to its official convenience, or through a petition based upon the conditions laid down in this decree.

Art. 6. It is understood that the service in all kinds of stations and lines cannot be performed, according to law, by others than by a staff from the telegraph body.

Given at the Palace, on the 30th day of March, 1864.

I THE QUEEN.

The Minister of State for Home Affairs,
Antonio Cánovas del Castillo.

THE ELECTRIC LIGHT—It does not appear to be generally known that lighthouse illumination, produced by a magneto-electric apparatus, has been in successful operation at the South Foreland and Dungeness beacon, for two years. Currents of air, produced by the rotation of masses of iron in the neighbourhood of powerful permanent magnets, generate the current of electricity, which ignites pieces of carbon intensely, thus producing the light.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 209.)

3. *Galvanometers.*

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit several forms of galvanometer.

1. An instrument which can be used both as a *sine* and *tangent galvanometer*, with extra coils or shunts of various resistances, each being a known fraction of the resistance of the galvanometer coils, and designed to be connected with those coils in multiple arc, so as to divert various fractions of the current, and reduce the sensibility of the instrument as may be required. The analogy, in virtue of which these auxiliary coils are called shunts, is sufficiently obvious.

2. A Gaugain's tangent galvanometer—that is to say, a tangent galvanometer, the coils of which form part of the surface of an obtuse cone, the apex of which corresponds with the centre of the suspended magnet. The angle at the apex of the cone is such that the height of the cone is equal to one-fourth of the diameter of the base. In this instrument the readings can be very conveniently taken, and the tangents of the deflections are said to be more truly proportional to the strengths of the current than in the old form.

In order that these tangents and currents should be strictly proportional, it is necessary, in the old form of the instrument, to suppose the suspended magnet to be infinitely short in comparison with the diameter of the deflecting coil; and if the true length were as great as one-sixth of that diameter, the want of strict proportionality might introduce an error of 30 per cent.; whereas, under the same circumstances, the error with M. Gaugain's instrument would not exceed $\frac{1}{3}$ per cent.* This instrument is also exhibited by Messrs. Digney Brothers, of Paris.

3. A very delicate astatic sine galvanometer, used for testing short lengths of submarine cable by measuring the deflections produced by the current from a given battery passing from the inside to the outside of the insulated wire. Indirectly, as already mentioned, the resistance of the sheath can be calculated from these deflections. This instrument is also used in connection with Messrs. Siemens' testing board previously described. The copper wire used for the deflecting coils makes 22,752 turns round the needle, and its resistance is 7,000 of Siemens' mercury units. The astatic system is suspended by a single fibre of floss silk, and the instrument is provided with a reading telescope, to avoid parallax in observing the position of the needle. It is similar in general arrangement to the galvanometers used by Ruhmkorff and Dubois-Reymond.

4. A marine galvanometer. This instrument is intended for use at sea in connection with the testing board. It consists of an astatic system, each magnet of which is surrounded by a deflecting coil. These magnets are supported on a vertical axis working on pivots. A strong adjustable directing magnet is fixed above the coils. This instrument is used in connection with the electric balance, to show simply the presence or absence of a current when the battery circuit is completed, as explained above. The deflections afford no *measure* of the deflecting currents.

Elliott Brothers, M. (United Kingdom, 2,897), show a convenient and cheap form of the common astatic galvanometer. This firm has taken especial care to provide diamagnetic copper for the coils: a point of importance in the very delicate differential instruments which they supply.

French makers show several excellent instruments of the usual forms.

J. White, Glasgow, M. (United Kingdom, 3,012), exhibits Professor W. Thomson's marine galvanometer. This instrument, designed and used for the tests of the Atlantic cable, allows every galvanometric measurement which can be made on land to be repeated at sea.

The suspended magnet is extremely small and light, and is fixed to the back of a little circular glass mirror, which, together with the magnet, weighs about $1\frac{1}{2}$ grain. The magnet and mirror are strung on a vertical bundle of stretched silk fibres passing through the centre of gravity of the magnet mirror, and secured both at top and bottom to a thin brass ring about $2\frac{1}{4}$ inches in diameter; on either side of this ring, and closely surrounding the mirror and magnet, are placed the two circular deflecting coils, having a small cylindrical opening in their centre of a diameter a little larger than that of the circular mirror. In this opening two stops limiting the deflections are placed behind the mirror, and a lens in front of it. A lamp placed in a frame with the magnet and coils at about two feet distance throws its light through this lens on to the mirror, which reflects the rays back through the lens, and this concentrates them into an image of the flame on a horizontal scale a little in front of and over the lamp. The reflected image traverses to and fro on the scale as the magnet and mirror are deflected to the right or left.

As the mirror and magnet are supported by their centre of gravity, the supporting frame may be moved in any direction without producing any change by the action of *gravitation* in the relative position of the mirror and its support; or, in other words, without altering the relative position of the frame, and the image on the scale. The effect of the *earth's magnetism* is equally neutralized by a very powerful horseshoe magnet fixed on the frame outside the coils. The directing force of this magnet on the suspended magnet is infinite compared with that of the earth. Thus, in spite of gravitation and of the earth's magnetism, this instrument may be moved into any position without altering the position of the little suspended magnet relatively to the frame, and consequently without altering the position of the reflected image on the scale. On the other hand, the passage of any current through the coils will always deflect the suspended magnet, and equal currents will have equal effects, whatever be the position of the instrument, so long as the directing horseshoe magnet remains constant; moreover, owing to the very small angular deflection which suffices to cause the spot to traverse the entire scale, the deflections of this spot may be taken as strictly proportional to the deflecting current. The image or spot may be adjusted to zero (which is in the centre of the scale) by moving the directing magnet with a screw adjustment provided for the purpose.

Galvanometric observations of all kinds can be easily made with this instrument in the roughest weather at sea; neither the continual alteration of the ship's course, nor the motion due to the waves, has any effect on the deflections. The instrument can be made either with differential coils, or with simple coils to be used in connection with a Wheatstone's balance, or it will indicate the loss by direct deflections. It may also be used as a receiving instrument for messages, since the movements of the spot of light can be as readily interpreted as those of any single needle receiver.

A jar will not derange the instrument, and there are no metal bearings which can rust; its practical value is now well known, and has been tested by several years' experience in the hands of various electricians. It cannot, of course, be made as sensitive as galvanometers with needles suspended by a single thread, and directed by the earth's magnetism, or, indeed, by a fraction of that magnetism; both the method of suspension and the power of the directing magnet reduce the magnitude of the deflections with any given current, but the action on the little magnet from the coils which so closely surround it is amply sufficient to render the instrument sensitive enough for all practical purposes when considerable lengths of cable are to be tested.

For very sensitive instruments to be used on land, the same general arrangement may be adopted without the directing magnet, and with the usual single thread suspension, instead of the stretched bundle described.

The messages which were for some time received through the Atlantic cable from America were translated from a somewhat similar instrument, by what Professor Thomson calls a human relay. A clerk worked the local circuit of a common Bain's receiver with a Morse key, by depressing and raising the handle as the spot of light moved in the one or other direction along the scale.

4. *Electrometers.*

James White, Glasgow (United Kingdom, 3,012), exhibits an electrometer, constructed by him according to the design of Professor W. Thomson, of Glasgow. The function of this instrument is to measure the difference of potentials between the earth and any given insulated body. The index of the instrument consists of an aluminium needle strung on a fine platinum wire passing through its centre of gravity, and stretched firmly between two points. The needle and wire are carefully insulated from the greater part of the instrument, but are in metallic communication with two small plates fixed beside the two ends of the needle, and to be called the needle plates or repelling plates. When uninfluenced by any electrical force the needle stands in a sighted position, which will be called zero, and it can always be brought back to zero by a torsion head turning one end of the platinum wire, but insulated from it. This torsion head is provided with a graduated circle, and the number of degrees of torsion required to bring the needle to zero measures the force tending to deflect it, as in a Coulomb's balance.

* Professor Thomson informs the writer that M. Gaugain's arrangement is apt to introduce an error of a distinct nature, and more serious than that corrected by it.

The needle and its repelling plates, considered separately from the rest of the instrument, would form a Delmann electrometer, with the variation of having the needle suspended by a metallic wire, and so kept in connection with the repelling plates, instead of being suspended by a glass fibre, and only temporarily connected with the repelling plates in the course of an experiment; whether positively or negatively electrified, the plates would repel the needle. This action is much modified by the presence of a second pair of larger plates facing the first-mentioned plates on the opposite side of the needle, and considerably further from it. These plates are in connection with the inner coating of a Leyden jar, which is intended to be permanently charged to a high potential either negative or positive, and they will be called the Leyden jar plates, or the attracting plates.

The whole instrument is enclosed in a metal cage to protect the glass of the Leyden jar from injury. The inner tinfoil coating of the Leyden jar, and a wire cage in connection with it surrounding the needle, protect it from the irregular electric action of surrounding objects. The action of the instrument is as follows: The Leyden jar and its plates are to be charged to a high potential—say negatively. Let the needle and its repelling plates be connected with earth, or, in other words, be maintained at the potential zero. The needle will then be deflected against a stop, under the combined influence of attraction from the Leyden jar or attracting plates, and repulsion from the small or repelling plates, due to the positive charge induced on the small plates and needle by the Leyden jar plates. The platinum wire must then be turned round by the torsion head so as to bring back the needle to zero, and the number of degrees of torsion required will measure the force with which the needle is attracted. The square root of the number of degrees observed is proportional to the difference of potentials between the earth and the inner coating of the Leyden jar, and will, therefore, measure this potential in a certain arbitrary unit depending on the size and position of the needle and plates, and on the stiffness of the platinum wire to resist torsion. This observation is called the earth reading.

Now let the needle and its plates be disconnected from the earth, and connected with the insulated body, the potential of which is to be tested. If the potential of this body be positive, the charge induced by the Leyden-jar plates in the small plates and needle will be greater than before. The needle will consequently be more attracted by the large plates, and more repelled by the small plates; if, on the contrary, the potential of the body be negative, the Leyden-jar plates will induce a smaller charge on the small plates and needle, which will consequently be less attracted by the large plates, and less repelled by the small plates: the needle will therefore be deflected to one or the other side, according to the sign of the potential of the body tested. The platinum wire must again be turned till the needle is brought to zero, and the number of degrees observed. The difference of potential between the Leyden-jar plates and the needle is in this case, as well as in the last, proportional to the square root of the number of degrees observed, and this new square root measures this new difference of potential in the same arbitrary units as are above alluded to. Thus the two square roots of what may be called the earth and test readings measure the two differences of potential of the earth and conductor tested, from one and the same Leyden-jar plate, in one and the same unit, and so the difference between the square roots will measure in the same units the difference between the differences, or what comes to the same thing, the difference between the potentials of the earth and of the tested conductor.

To express this mathematically, let a be the number of degrees observed for the earth reading, and b the number of degrees observed for the test reading; also let the potentials of the Leyden-jar plates, the earth, and the tested conductor be called L, E, and T respectively. Then we have

$$E - L = \sqrt{a}$$
$$\text{also } T - L = \sqrt{b}$$
$$\text{therefore } T - E = \sqrt{b} - \sqrt{a}$$

that is, the difference of potential between the earth and the body observed will be measured by the difference of the square roots of the degrees of torsion observed. The units in which this measurement is expressed will be unaffected by any change in the potential of the Leyden-jar plates—a most important and, indeed, essential feature of the system; for whatever be the value of L in the above equations, it is eliminated from the final result. It is only essential that during the two observations of a and b, the potential L should remain constant, a condition which is easily fulfilled during some hours with the present instrument. The sensibility of the instrument varies, however, with the potential of the Leyden-jar plates, increasing as this increases; for the required measurement is equal to the difference of two numbers, large when L is large, and small when L is small; and although this difference is constant, the difference of the squares of these numbers, which are the readings actually taken, will be by no means constant, but will increase as the numbers themselves increase; thus, let $T - E = 3$, and $E = 0$,

$$\begin{aligned} &\text{then if } L = -1, & E - L &= 1 = \sqrt{a}, &\text{and } a &= 1, \\ && T - L &= 4 = \sqrt{b}, &\text{,, } b &= 16; \\ &\text{but if } L = -10, & E - L &= 10 = \sqrt{a}, &\text{,, } a &= 100; \\ && T - L &= 13 = \sqrt{b}, &\text{,, } b &= 169; \end{aligned}$$

so that in the first case the difference between the a and b which measures the sensitiveness of the instruments is 15, and in the second case 69; or, in other words, the instrument was, by charging the Leyden-jar plate to a potential 10, made more than four times as sensitive as when the Leyden jar was charged to only 1.

A single comparison of a measurement of $T - E$ so obtained with the measurement of the difference of potentials by an absolute electrometer, gives a co-efficient by which this, and all other measurements, can be reduced to absolute measure. (By absolute electrometer is meant an instrument which measures the difference of potentials in electro-statical absolute units depending on time, mass, and space only.) Any loss of charge from the Leyden jar which may from time to time occur, reducing the sensibility inconveniently, may be made good by additions from a small electrophorus which accompanies the instrument.

Measurements could be obtained if the needle-plates were quite removed, but the deflections would be diminished, and what is of more consequence, a reading taken with the needle deviating very slightly from the true zero position would entail a great error in the measurement recorded. In other words, one object of the needle-plate is to give sensibility to the zero position of the needle by causing a great alteration in the force experienced by it, when deviating a little to the right or left of this position. If the Leyden-jar plates, instead of being permanently charged, were simply connected with the earth, deflections would still be obtained when the needle is charged, and the sensibility of the instrument would even thus be somewhat greater than that of a Delmann electrometer, in virtue of the attracting or Leyden-jar plates; but no distinction would be shown between positive and negative electricity. The effect of charging the Leyden jar is twofold: it increases greatly the sensibility of the instrument, and allows us to distinguish between positive and negative electrification.

The atmosphere inside the jar is maintained in an exceedingly dry state by pumice-stone slightly moistened with sulphuric acid, and thus the very perfect insulation required is obtained. The insulation of the jar is such that it will lose a charge only at the rate of about 1 per cent. per diem when in very good condition, and 5 per cent. per diem when in indifferent condition. One earth reading therefore suffices for comparison with a series of test readings (made for example in a balloon), occupying several hours. Electrodes or terminals are brought outside the instrument, by which the Leyden jar can be charged, and the needle system connected with the body to be tested. The needle is so accurately suspended by the centre of gravity, that the deflections are independent of the instrument, and observations can be made on it when held in the hand, and even when in motion. Along with the instrument are exhibited arrangements for testing the potential of the atmosphere. This is done by means of a burning match in connection with the needle system when the instrument is moved from place to place, and by a water-dropping collector when stationary.

Mr. White, the exhibitor and maker of this instrument, has shown great skill in the successful execution of the difficult details of Professor Thomson's novel and ingenious contrivance, a more complete description of which will be found in a paper read before the Royal Institution by Professor W. Thomson on May 18, 1860, and also in an article on atmospheric electricity in the second edition of Nichol's "Cyclopœdia of the Physical Sciences."

Elliott Brothers (United Kingdom, 2,897) exhibit a convenient form of Peltier's electrometer, in which the needle and repelling plates are insulated by a composition of gum damar and Venetian turpentine. These instruments retain a nearly constant charge for some time unaided by an artificially dried atmosphere. At the end of twenty-four hours the deflection due to the charge will frequently be found not to have fallen more than one-half.

ON THE PATENT LAWS.

In our last we published a very important paper, on the above subject, from the pen of Thomas Webster, Esq., M.A., F.R.S., which was read at a recent meeting of the Society of Arts; we now lay before our readers a report of the interesting discussion that followed, in the course of which some novel ideas were ennunciated by the various speakers.

Discussion.

Mr. Robert Wilson would say a few words on the improvement of the existing patent laws, rather than go into the more abstract question whether those laws were expedient in themselves. For his own part he could not see how they could expect to maintain invention if they deprived it of its reward. In his opinion the first question to be considered was whether they could amend the existing laws: and he thought it possible to do so in many important respects. One great improvement would be to enforce precision in the specification of the invention. It was a condition in every patent that the patentee should, within six months, file a specification describing his invention, and the manner in which it was to be carried into effect. But how was this complied with? In a large number of cases at the present day patents were taken out, not for things entirely new, but for modifications of existing inventions, and in such cases he submitted the description might clearly distinguish what was new from that which was old. But those who were conversant with the subject knew that such was not the case, for it constantly happened that patentees put in descriptions which did not distinguish clearly the new from the old, but left it to the public to pick it out for themselves, instead of saying "the old machine is defective in certain points, and I have introduced a certain improvement," and then described the whole machine, pointing out distinctly the improvement which he sought to introduce and make the subject of his patent. Patentees, however, generally began with an obscure description of the machine as a whole, and then referred to the alteration or modification proposed to be introduced; they so worded this description as to cover any possible combination or arrangement in which this might be carried out. They then waited to see what other people where doing. After a time they attacked some man for infringement, and endeavoured to show that what he was doing was covered by the words of the specification; an action was then brought, able counsel engaged to describe the combination, beautiful models were prepared to exhibit these combinations, an array of witnesses were called to say that such a combination was found in the specification. Such a state of things was most injurious and dishonest, and this could be remedied by compelling every patentee to describe distinctly and clearly the exact nature of his invention. Again, it frequently happened that much colateral and irrelevant matter got into the case—the case went to a hearing before a jury, and the heads of the jury, and even the judge, were so full of the plaintiff's good deeds, as detailed by his counsel, and the defendant's iniquity, that it was next to impossible to divest them of that prejudice. The case went on, perhaps for weeks, and in the end the jury found for the plaintiff. The defendant, no doubt, could and did apply for a new trial, which might or might not be granted, and if it was a case of great importance an appeal might be made to the House of Lords, and after two or three years' litigation it might be, and frequently was, discovered that the thing which had been the subject of the contest was not in the specification at all, and had not been claimed as the subject of the patent. In the end it was found that the patent was bad, and the defendant gained the day, but at a heavy expense, a portion only of which he could recover from the plaintiff, and this only if the latter was capable of paying it. Such, he believed, was not an over-coloured history of a great many patents. What was the remedy for this? It seemed to him that it should be the duty of the judge, in the first instance, to see what was in the specification, and what the patentee claimed for his invention. If the patentee had not stated this so distinctly that people could understand what the invention clearly was, and how it was to be affected, the plaintiff should be nonsuited, and the defendant should not be called upon to defend himself. He would give a case in illustration of this. It was well known that litigation had been going on for a long time relative to the patent rights of a certain sewing-machine. A gentleman, of whom he desired to speak with all respect, had purchased the patent rights in a certain sewing-machine in America for £50, and this of course he had a right to do, and, if the patent were good, to have the benefit of it. An action was brought against his (Mr. Wilson's) client for infringement, and the plaintiff was nonsuited. He then brought an action against the same party before another judge, and at the end of six days the special jury, not being able to agree upon a verdict, were discharged. The same plaintiff then brought another action, which lasted three or four days; and at the end of that time the defendant, though advised that the patent was bad, was induced to submit to a verdict on certain terms. The plaintiff having so far succeeded, then attacked every one who he considered was infringing his patent, and filed a separate bill in Chancery against them, somewhere about 130 separate Chancery suits. An application was made to one of the Vice-Chancellors to consolidate this litigation, and to decide the case in one trial; but this was refused, and if it had not been for the Lord Chancellor, who would not allow such a scandal to be perpetrated, there would probably at this time have been 130 suits in Chancery going on on this matter. The Lord Chancellor, however, insisted upon having the whole thing tried in one suit before him, and at once called attention to the specification, sitting day after day in order to give the plaintiff's counsel full opportunity of showing that what was relied upon was covered by the specification. It turned out, however, that the invention claimed was nowhere to be found in the specification at all, and the Chancellor upset the patent. These facts went to show the necessity for explicit description. There was, however, another matter to which he desired to draw attention. When the defendant in a patent case put in his pleas he was bound to deliver a statement of his objections to the validity of the patent. Those objections generally consisted in the recital of a mass of specifications of a number of other patents alleged to have anticipated the invention in question, and counsel had to sift from this mass of matter what was really of value to the case, whereas the defendant should be required to point out and define what particular parts of these specifications he relied on for his objections. There was another point to which he would refer, and this affected the principles on which a patent was granted. At present a patent was granted for any new manufacture. If a man took out a patent for a machine that would not work, or for a candle that would not burn, the patent was void, because they were not manufactures at all; but suppose a man took out a patent for a machine which would work, or for a candle which would produce light, he apprehended the patent was in itself good, though the machine might be less effective, or the candle less brilliant, but at the same time more costly, than those formerly in use. In other words, the patent law required absolute and not relative usefulness. He could not conceive on what principle a man should have the right of shutting out other people for three, seven, or fourteen years, unless the invention conferred some benefit upon the nation by publishing it. Therefore, he contended, a change was required in the principle of the patent laws from novelty to actual merit. He thought it would be found it was not impossible to work this out. Suppose they had first of all the application for the patent as it was at present: the patent would date from that time. Then suppose the specification was filed: then the third stage would be the sealing of the patent. At this stage the specification would have been printed in detail, and the patentee should then make a formal application for the sealing of the patent, and this might come on to be heard in public before the new Patent Court, or some such tribunal, and the patent could be sealed or not after hearing all that could be urged in favour or against it, and thus an immense amount of rubbish would be got rid of, and people would be more careful in applying for useless and obstructive patents. This plan would effect what had been suggested in the paper, viz., a preliminary investigation, the only difference being it would be done publicly instead of privately, avoiding proceedings liable to much abuse. At the same time he would reserve the right of appeal to another court, although under such circumstances he thought the appeals would not be very frequent. Such a proceeding would be very analogous to the applications made to the Privy Council for a prolongation of the term of a patent. It had been objected to this course that a poor inventor would thus be led into litigation before he could have made anything by his patent. The answer to that was that there was no reason why it should cost the plaintiff anything. He might go before the lower tribunal, or even the Privy Council, and describe his patent himself, then there would be no cost. Then it might be said that a proceeding of that kind would shut out many good patents and let in many bad ones. It might be said such inventions as gas and the screw propeller would never have passed through such a preliminary investigation. The answer to that was, that when an invention was laid before a body of scientific and competent men it was not likely to be pooh-poohed, if it was a valuable invention. Besides that, the necessity for merit would be less in the case of an invention of that kind than in the case of an invention which dealt with an existing manufacture. If a man now applied for a patent affecting an existing trade, it should be shown that the invention was a good one: but if it did not interfere with others, as in the case of the screw propeller, it might pass with much less belief in its merits on the part of the court of investigation than in the other case, or the hearing might even be postponed, and the patentee might come again. He thought it was impossible to defend the patent laws as they existed, and the system was getting worse. They must either improve this system, which he thought might be done, or make up their minds to give up the patent laws altogether.

Dr. Collyer thought the subject of patents admitted of easy and simple elucidation. Men who had money did not, as a rule, devote themselves to invention. To be an inventor necessitated a prior education and intelligence. There were exceptional cases; but almost all the great inventions had been accomplished and perfected stage by stage, and year by year; and those who were most conversant with inventions and inventors, knew very well that invention begat invention, and in the majority of cases it required a large expenditure of money to put them into practical execution. Defects had to be remedied, and it was only after many years that an invention was perfected. At the same time there had been valuable inventions, no doubt, which had not gone through those stages. The steam-engine of Watt had to pass through all these stages, and even now improvements in the steam-engine were daily going on; and were it not for the protection which the patent laws afforded, very few men would devote their time and intelligence to invention. Many men were called inventors who had no right to that title. A host of patents existed which

were the cause of the objections raised so constantly against the patent laws. This would be met, as suggested in Mr. Webster's paper, by a preliminary examination. That plan had been very successfully carried out in America. With regard to the value of an invention to the authors, that could not be anticipated. The value of it could only be determined by the working, after a sufficient time had elapsed. He had himself taken out no fewer than fifteen patents on one subject, and he believed he had now arrived at something like perfection. He would like to see the patent laws revised. They all felt the difficulties that had been pointed out by Mr. Webster, but he would say, as an inventor, he hoped that these difficulties would not deter them from endeavouring to amend the system, and retain the patent laws, to abolish which would be to rob a man of the fruits of his intelligence, honest perseverance, and industry, and be a disgrace to the advancement of civilization.

Dr. BACHHOFFNER, as the proprietor of several patents, had no hesitation in stating that the present law was a delusion and a snare. But, though much might be said against the system itself, much more might be said against inventors. The gentleman who first addressed them had given a graphic description of the intricacies of the law. One of the most ticklish things of all was the provisional specification, and next the final specification. He would appeal to Dr. Collyer whether the object of the inventor was not to disguise as much as possible what was intended to be done, and to tell the public as little as possible for fear of infringement. A man might invent, or fancy he had invented, something that had not been invented before, and the difficulty was to know whether any one had invented such a thing previously. A cautious patent agent would advise him in his specification not to claim anything specific, but to leave it open to his opponents, if he had any, to find out what he did claim. That was the state of patent specifications generally in this country. He fully concurred in the view taken by Mr. Webster as a fair and proper one, but there were great difficulties connected with it. It had been suggested that there should be a judicial council to investigate the claims to patents; but in the case of a chemical patent, how could a fair decision be arrived at when the process dealt with was an entirely new treatment or combination of chemical elements? If the patent were granted, it must be on the *ipse dixit* of the applicant, and rights would thus be created with possible injustice to others, because a patent when thus granted, to be of any value at all, must be one that could not be overturned. As the law of patents now stood, when an inventor had paid the money for the patent, all he got was the privilege to go to law to defend it. The subject was one which it well became this Society to grapple with—how he scarcely felt competent to suggest—but it was important that something should be done to wipe away this great disgrace from the laws of the country.

Mr. PAUL remarked that before they could consider how invention was to be encouraged and inventors rewarded, it was necessary to define what was an invention. No doubt many of the patents granted were not valid, and the majority of them were neither novel nor useful. Mr. Webster, in his paper, had pointed out what he considered a distinction between discovery and invention. He must say he could not altogether realise the distinction which had been thus drawn, and he regarded many patented inventions as essentially discoveries. It was difficult to assign to each particular individual the degree of credit that belonged to him, and that remark applied to almost all the subjects for which patents could be obtained. As the knowledge of scientific principles became enlarged the area of novel invention became more and more narrowed. That was particularly the case in the matter of chemical patents. It was almost impossible to say with regard to chemical patents where the novelty of the invention was, what particular portion of it that was essential to the process was new, and what portion though essential was old. It occurred to him that it might be of great advantage if the character of novelty in these matters were somewhat less strictly insisted upon or limited, so as to admit of retrospective application. In the distinctions drawn by Mr. Webster between discovery and invention, vaccination had been adduced as an illustration of the argument. The novelty as well as the utility of that practice had been established, but yet vaccination was stated to be incapable of reward as an invention; at the same time patents were granted for medicines that were to cure all imaginable diseases. There appeared to him an inconsistency in this. With regard to the reward to inventors and the property in inventions, the inventor was not always the person rewarded by the operation of the Patent Law.

Lord ALFRED CHURCHILL, M.P., said that the patent law of this country was in a most unsatisfactory condition, and that amendments in it should be made was almost universally admitted. The great difficulty was to discover the direction in which the amendment should take place. They could not disguise the fact that in the opinion of many persons it would be best that the patent law should cease altogether, but he for one could not admit that, until some other means were adopted for giving a fair reward to inventors for what they produced. The proposition he thought deserving most attention was the third which had been submitted by Mr. Webster in his paper, viz., that the owners of a patent should be compelled to grant licenses, or to sell the whole right, for the benefit of the public, on adequate consideration. Now the very same idea occurred to him, and he had embodied that principle in a skeleton bill, which he had submitted to the consideration of his friends. The object of that bill was that a patentee should not possess an exclusive or obstructive monopoly in the use or manufacture of his invention, but that he should have full claim to a royalty from other persons for making use of his invention. He proposed in this skeleton bill, first, that no monopoly clause should be introduced; secondly, that parties obtaining patents should declare what royalty they considered would be a fair remuneration to them; thirdly, that the amount so declared should be advertised in the most public manner; and fourthly, that at the end of six months or any other fixed period the public generally or any manufacturer should have power to object to that royalty, and that then the amount should be decided by arbitration. He thought if these points were well considered they would find that inventors would obtain ample remuneration. He could imagine no greater misfortune to a man without means than to be an inventor. He knew of thousands of cases in which men had been ruined by their own brains. If they could have the means of placing their inventions before the public in some such way as he had pointed out, with a certainty that they would obtain a royalty proportionate to the value of the invention, they would not be induced to follow the course mentioned by Dr. Bachhoffner, of drawing out their specification in such a way that nobody could know the meaning of it. On the contrary, they would be anxious to state the nature of the invention as clearly and fully as possible, in order to obtain the royalty which attached to it. He was glad to find that this idea had been entertained by Mr. Webster, and he had no doubt that gentleman, with his large knowledge of the subject, would be able to apply it in a practical and useful manner.

Mr. PETER GRAHAM said he would offer one or two observations on the general policy of granting patents. The broad principle to be considered was this, viz.—whether the granting of patents conduced to the progress and improvement—and thereby to the benefit—of the public? It had been lost sight of so far, that something more than mere invention was required —it had to be brought into practical use. An invention was often attended with many trials and difficulties, and in some cases thousands of pounds were expended before any practical results were arrived at. Men would not be foolish enough to waste time and risk capital unless there were some chance of ultimate advantage from it. Hence, he contended that the principle of the patent law was just, and tended to progressive improvement and public benefit. With regard to the application for extension of the term of patents, he thought this was necessary; when a man brought forward a new invention, affecting an established manufacture or trade, he had all prejudices to contend with before he could bring it into use, and unless he was in a position to carry it out himself, he must find persons willing to bring it forward, and great sacrifices were frequently necessary to this end. He recollected when the power-loom was first adapted to the manufacture of Brussels carpets. The inventor, in the first instance, took it to Kidderminster, the great seat of that manufacture. The answer given by the manufacturers was, first, that they did not believe that it was practicable, and secondly, if practicable, they did not desire any change or improvement in the carpet manufacture. In another instance, in which an ingenious man invented a new thing in connection with the same branch of manufacture, it was agreed to put the thing to work, but the parties afterwards paid the forfeit of £200, and gave it up. However, the invention was subsequently applied by the inventor himself, and it had been the foundation of one of the most colossal manufactures in this country. Would any one tell him that the inventor would have spent his time and money in that way if his invention had not been protected by a patent, and if he had not had anticipations of reaping the reward of his invention? With regard to the means of obtaining patents, he thought that at present they were obtained with too great facility. The suggestion of Mr. Webster, with reference to that point, was a good one; but with regard to Mr. Wilson's proposition, he did not think it practicable, for a poor man would not have the time and money to do it, and, as had been remarked by a previous speaker, rich men were not generally inventors. They found capital to perfect the inventions of others, but they were not the real inventors. They had large manufactories or warehouses, and they were, in many cases, content to continue as they were, and did not encourage inventors to come amongst them. No doubt thousands of patents were perfectly useless, and in like manner there were a great many laws on the statute books which might be abrogated with benefit to the community. He thought the suggestions of Mr. Webster for the improvement of the patent laws were valuable. He thought the public, and particularly the Society, were indebted to that gentlemen for the manner in which he had brought this subject forward. He agreed with every principle laid down, and with every opinion expressed in the paper, having for the last twenty years had much to do with many patents.

(To be continued.)

THE INDIAN TELEGRAPH.—The following telegram was received at the India Office on the 2nd inst.:—"Colonel Stewart requests me to inform Sir Charles Wood that the cable was landed at Fas on the 29th March, and its junction with the Turkish line was effected on the 8th of April. The telegraphic line between Irak and India is now completed, and works nicely. Communication between Bussorah and Kurrachee takes place in five minutes. Two English steamers ply on the Tigris; a third one expected from Kurrachee, to convey correspondence till completion of the Irak line (Persian line); will be completed in July."

DABOLL'S FOG SIGNAL.

(*Continued from page* 210.)

We trust that the reproduction in our columns of this interesting Report, will incite some of our readers to invent a code by which the trumpet, bell, and gun, can be made the means of communicating between the shore and the vessels at sea, so as to warn them of the danger of their position.

REPORT OF A COMMITTEE OF THE ELDER BRETHREN, WHO PROCEEDED TO DUNGENESS TO TEST VARIOUS FOG SIGNALS.

Mr. Daboll's fog-horn having been so fully reported on by the last committee, it would be needless repeating the same, but the machine was in the same position as before, and attended to by a skilled engineer.

An 18-pounder gun had been placed on a platform placed in line with the fog-horn, 100 feet to the eastward of it, manned by some of the Coast Guard.

Mr. Holmes' steam whistle was unable to be used, the steam pipe having burst from the frost.

The following programme of experiments was arranged and carried out, the day, peculiarly adapted for the purpose, being fine, with light variable airs, and calm and smooth water :—

Fog-Signal Experiments, on Friday, 8th January, 1864.

The experiments to commence at 1 p.m., in the following order :—

	H. M.	H. M.	H. M.	H. M.	H. M.
1. Daboll's horn, for 3 minutes	1 0	1 12	1 24	1 36	1 48
2. Gun	1 3	1 15	1 27	1 39	1 51
3. The bell, for 3 minutes	1 6	1 18	1 30	1 42	1 54
All together, 2 minutes continuously	1 9	1 21	1 33	1 45	1 57

Recurrence of the Series as in the Table :

To be observed in three directions right off the point, and in a line in a S.W. and N.E. direction at half a mile, 1, 2, 3, and 4 miles.

Another series of sounds, beginning at half-past two o'clock :

Altogether for 2 minutes.—Silence for 2 minutes.

Altogether for 2 minutes.—Silence for 2 minutes.

Observed at different distances in a line directly off shore ; repeated for half an hour.

Noted :—

1. Daboll's Horn.—Pressure of air, 10 lbs. to square inch.
2. Gun.—Description : 18-pounder ; weight, 22 cwt. ; charge of powder. 3 lbs.

No. 3.—Bell ; weight, 10 cwt. ; diameter, 37 inches.

Bearings of lighthouse for Series No. 1, N. ; No. 2, E.N.E. ; and No. 3, W.S.W.

State of Weather.—Calm, with variable flaws all ways.

From 1 to 1.15 p.m.—Lighthouse bearing north 1 mile ; light air from the westward ; very smooth water ; paddles stopped.
Daboll's horn heard but indistinctly.
Gun sounded like a musket.
Bell more distinct than either horn or gun.
Bell and horn both going together ; horn most distinct

From 1.15 to 1.24 p.m.—Lighthouse on same bearing ; weather calm.
Daboll's horn heard much better than before.
Gun sounded better also.
Bell very good ; almost equal to the horn.
Bell and horn together ; horn had the advantage.
With the paddles going, neither heard very distinctly.

At 1.30 p.m.—Lighthouse on the same bearing, two miles off. Weather calm, with the paddles going. The flash and smoke of gun were seen, but no report heard. Paddles stopped.
Bell barely heard.
Bell and horn both going together ; horn had the advantage.

At 1.36 p.m.—Horn alone ; very fair.

At 1.39 p.m.—Gun ; very good.

At 1.42 p.m.—Bell ; faintly audible.

At 1.45 p.m.—Bell and horn together ; both very indistinctly heard, but equal in sound.

At 1.48 p.m.—Horn only once in three minutes ; indistinctly heard.

At 1.51 p.m.—Gun ; very good.

At 1.54 p.m.—Bell ; just audible.

At 1.57 p.m.—Horn and bell together ; the horn very good.
Bell only just audible.

At 2.6 p.m.—Lighthouse still bearing north, but three miles off ; very light air from the eastward, almost calm.
With the paddles going, the flash and smoke of the gun were seen, but no report heard.
Paddles stopped.
Bell not heard.

At 2.9 p.m.—Horn faintly heard, but good for the distance.

At 2.12 p.m.—Horn distinct, and marked.

At 2.15 p.m.—Report of gun very good.

At 2.24 p.m.—Lighthouse on same bearing, four miles off.
Horn not heard.

At 2.27 p.m.—Gun heard faintly.

At 2.30 p.m.—Bell not heard.

At 2.30 p.m.—Turned round and steamed in towards the lighthouse, and stopped at 3½ miles off.
Horn heard very faintly.
Bell not heard at all.
Proceeded in to 2½ miles.

At 2.52 p.m.—Horn heard very fairly.
Bell very indistinctly heard.
Proceeded in, and sent a boat on shore, with instructions for the experiments to be repeated.

At 3.30 p.m.—Calm ; lighthouse bearing N.E. by E. ½ E. one mile ; stopped.
Bell very distinctly heard.
Horn the same.
Steamed on to the westward, lighthouse bearing E.N.E., distant two miles.

At 3.40 p.m.—Gun pretty good, with the paddles just moving.
Paddles stopped.
Bell faint, but not continuous.
Horn faint.
Gun very distinct.

At 4.33 p.m.—Proceeded to the eastward, lighthouse W. by S. ½ S., one mile ; light south-easterly air.
Gun very distinct.
Bell very good.
Horn not so good as bell.
Proceeded on to the eastward ; lighthouse S.W. by W. two miles.

At 4.47 p.m.—Bell distinct, but not continuous.
Horn very faintly heard.
Gun very distinct.

The committee having submitted the detail of these experiments, would record their unanimous opinion as follows :—

That the gun was proved to be the best warning signal.

That the fog-horn in its line of axis has an advantage of one mile beyond the bell.

That out of that line, at a distance varying from one to two miles, the horn and bell were on an equality.

That the fog-horn in calm weather may be considered in its line of axis to have a range of 3½ miles, but out of that line not more than two miles.

That the bell in similar weather would give a good warning sound all round, to the distance of two miles ; or,

That either horn or bell would furnish sufficient intimation of danger to a sailing vessel ; but that for a steamer with her paddles going, neither gun, horn, or bell would be of the slightest advantage, except at a short distance.

(Signed) H. Shuttleworth. Chas. G. Weller.
E. P. Nisbet. G. P. Lambert.
F. Arrow.

The Secretary, Marine Department, Board of Trade, to the Secretary, Trinity House.

Board of Trade, Whitehall, Feb. 15, 1864.

Sir,—I am directed by the Lords of the Committee of Privy Council for Trade to acknowledge the receipt of your letter of the 3rd instant, and, in reply, to acquaint you, for the information of the Elder Brethren, that the Board of Trade sanctions the purchase of one of Daboll's 32-inch fog-trumpets for the sum of £950, as recommended in your letter.

I am, at the same time, to request you to direct the attention of the Elder Brethren to some points which are essential to a thorough investigation of the practical merits of this machine.

It is evident, from the trials which have already been made, that the effective power of the trumpet is very seriously diminished when passing away from the line of the axis or mouth ; so much so, that whereas it was distinctly heard at a distance of two and a half miles, when the Trinity House steamer was in the favourable position, it was necessary to approach within one-third of a mile when the vessel was at right angles to the axis of the trumpet. This is a serious defect ; for whilst the trumpet, with its axis directed out to sea, might be heard distinctly by passing vessels, others might approach it on either side, and run ashore in the adjacent bights of the coast without receiving any warning. But probably this defect could be remedied, and it might be possible to contrive that the trumpet should revolve in an arc, so as to throw its whole or maximum sound seaward round the horizon.

The Board of Trade would also be glad to be informed if any experiments have been or can be made with a fog-trumpet at the height of 100 or 200 feet, and in a dense fog, in order to ascertain how its sound is, under these circumstances, projected over the sea. It is well known that a dense fog often affects sound, and renders it difficult to ascertain the direction from which it proceeds, and it is possible that a fog-trumpet, by throwing its maximum sound in one direction only, may occasion very deceptive conclusions.

The Board of Trade would be glad to be informed of the result of the investigation of these points by the Elder Brethren.—I am, &c.,

To the Secretary, Trinity House. (Signed) T. H. Farrer.

CORRESPONDENCE.

BONELLI'S TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In replying to my remarks made on the shortcomings of Bonelli's multiple wire system, "Henry Cook" presumes on his own convictions.

When stating that from five to nine wires were employed, I certainly might have said from five to thirteen; for every odd number, from thirteen down to five, seems to have been proposed and tried. (See *Record of Practical Mechanic's Journal on Exhibition*, 1862; *Fleeming Jenkin's Report*, &c.)

Five times the length of wire costs every farthing five times the amount of single length, so do the insulators; and only H. C. could suppose I meant to put five times the number of posts also; still he incorrectly gives the price as rather under double. It will be quite two and a half times that of a single line, and then no provision is made for stronger posts, which he ought to have. But how about maintenance? H. C., no doubt, does that gratis altogether.

I do not believe Bonelli's instrument can do as much with their five wires as Hughes', Wheatstone's, Siemens', and others, do with two—nor will H. C., by mere assertion, persuade me into such a belief; and I further most seriously question the *necessity* of a Roman type telegraph. Encourage compositors to study the Morse alphabet by an extra half-a-crown per week, and they will go to work with the Morse strips as fast as with Bonelli's.

About the fearful chances against the efficiency of the line which H. C. appears to consider *nil*, I will only add this much. Experience has taught some of us—and any rudimentary treatise on the history and progress of telegraphy may teach the rest—that a dozen of systems, as beautifully conceived as Sig. Bonelli's, have gone into oblivion because they required too many line wires.—I remain, &c., G. R.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Perhaps a few lines from one who was present on the occasion of Mr. Cook's lecture on the "Bonelli Instrument," and conversant with the subject, may not be out of place. There is no science so little understood by the public as telegraphy, and nothing is more easy than to exhibit an instrument in a room, and to produce seemingly wonderful results (which, however, were not arrived at on Tuesday); but it is an entirely different matter in practice.

The drawback to Bonelli's instrument is, that it requires five wires to work it, and there are no two towns in the United Kingdom, except, perhaps, Liverpool and London, where five wires are wanted; and even between those points, in order to avoid repetitions, I understand that the wires are led into different places, and the messages are sent without a break; but on the Bonelli's system all the messages would have to be forwarded to one station and thence retransmitted, causing a liability to error and considerable delay. In order to send messages at the same moment, say, to Cork, Queenstown, Limerick, and Waterford, as is, I believe, done at present with one wire to each town, Bonelli would require five wires to each town,—in all, 20 wires to do that which is now accomplished with four wires; and the cost of construction and maintenance of the lines would be increased in nearly the same proportion.

In the case of a break-down (and these occur frequently on telegraph lines) the Bonelli company would, I presume, use some other description of instrument, so that the 8*s*. per week type-setters, alluded to by Mr. Cook in his lecture, would be useless, and the company would require to have a highly paid staff at each station in reserve.

With regard to speed and accuracy, a signal, in my opinion, can be sent much quicker by telegraph than the most experienced compositor can set up type; and it is just as likely that a type-setter may make a mistake from the manuscript as that a clerk would send a wrong word.

It was elicited from Mr. Cook that the Bonelli Company intend only to use the Bonelli instruments between the large towns, and the company would, therefore, require to avail themselves of another system of telegraph, which must necessarily add to the cost of working, and greatly interfere with their operations.—I am, sir, your obedient servant,

April 27. CIVIS.

TELEGRAPHIC NEWS.

THE MAGNETIC TELEGRAPH COMPANY.—We understand that the above company have entered into working arrangements with the South Eastern Railway Telegraph Company. Messages can now be transmitted direct through both company's wires to all parts.

THE MADRAS AND BANGALORE TELEGRAPH.—From the report of the Madras Railway Company, we learn that the telegraph line in the south-west district is in good working order, and that Bangalore has been placed in immediate communication with Madras.

THE SUBMARINE TELEGRAPH COMPANY.—This company has arranged to open a branch office at 43, Regent Circus, the west-end business of the company having hitherto been carried on at the office of the Magnetic Telegraph Company. The office will be open for messages daily from 8 A.M. to 12 P.M.

COMMUNICATION BETWEEN LONDON AND SIBERIA.—During the last twelve months a line of telegraph has been opened between London and Tuvnen, in Siberia, a distance of 4,039 miles overland. The continuation to Nicolaiwski, on the Pacific, is now probably accomplished; and the connexion, viâ California, with New York is confidently looked for in the ensuing year.

ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.—Two lines of pneumatic tubing for the transmission of telegraph messages are being laid between the above company's chief station in Castle-street and the two branch offices in Water-street and Royal Exchange-buildings, Liverpool. The pipes are 2½ inches in diameter, and are to be worked by a novel pneumatic arrangement introduced by Mr. Varley, a full description of which will be given in a future number.

PERSIAN GULF CABLE.—Her Majesty's ship Dalhousie sailed from Bombay for Mussendom on the 16th March, with the Euphrates and Constance in tow, loaded with plant for the various stations. The whole telegraph fleet will then have left our harbour for the Gulf, with the exception of the steamer Amberwitch, which will follow as soon as she comes out of dock. It is stated that Persia has objected to the line of telegraph being carried along the coast of Mekran, and expresses herself disinclined to respect any treaty we may have with the Sultan of Muscat. We are not aware on what authority this information is given, but under any circumstances England is not likely to yield to a claim which the local chiefs repudiate, and which there is every reason to suppose the Shah of Persia could not make good. The territory of Gwadel, concerning which the difference is said to have arisen, is under the authority of the Sultan of Muscat; with him our arrangements have been made, and we can scarcely believe that Persia will be imprudent enough to attempt to interfere with them. It is always well to let sleeping dogs lie.

THE UNITED KINGDOM AND BONELLI COMPANIES' PROPOSED COMPETITION.—Since our last issue the following correspondence has appeared in the daily journals upon this subject:—United Kingdom Electric Telegraph Company, April 30, 1864.—Dear Sir,—In reply to your letter of the 28th inst., I beg to state that your company accepted the challenge of this company, which I again quote, as follows, viz.:—"The Directors of the United Kingdom Company challenge the Bonelli Company to a competitive trial of the system they propose with the system of the United Kingdom Company between Liverpool and Manchester, and are prepared to prove the Bonelli system, wire for wire, to be slower, infinitely more costly, and from the number of wires required, impracticable."—You now say that you cannot come to terms, because the conditions this company proposes are inadmissible, and because this company proposes to try the ink-writing Morse, although at the time you accepted the challenge you perfectly well knew that at present that instrument formed the largest part of this company's system. As the trial of the Morse would entail trouble only on this company, and would not interfere with your part of the trial in any shape or way, why do you object at present to compete with it? You state that you shall proceed to work out the terms you proposed to this company, which your directors consider a fair basis. These, irrespective of apparatus, were as follows:—You proposed to us to work with five wires, thus asking us to adopt an objectional feature of your system. You proposed that each company might call for the other company's wires—a condition which we, with our extensive business, manifestly could not comply with. You proposed that, if an error occurred in a message, the message should be repeated again and again until correct—a great disadvantage of your system, which we declined to make our own, seeing that on either of our systems an error is instantaneously corrected. You proposed no certain period over which the trial should extend, and expressly provided that the experiments might be stopped at any moment at the discretion of the umpires, practically unacquainted with the working. You proposed no arrangement whatever upon that part of our challenge to prove the "impracticability" of using an instrument that cannot work with less than five wires, and you evidently imagined that this did not apply to "commercial" as well as to "mechanical" impracticability. This company, on the other hand, desired experiments extending over a lengthened period, several hundred messages per day, and newspaper expresses, to be forwarded. The apparatus, staff, and expense to be fixed beforehand. The mechanical, electrical, and chemical appliances to be explained beforehand, and no departure from the basis so settled to be permitted. That no other instruments should be employed to convey instructions, or to assist to correct any faults in the apparatus under trial. We proposed to take the basis of your own prospectus for the work to be done, and for proof of the statements made in that document as to what your company have accomplished up to this time on your line from Liverpool to Manchester. Nothing, surely, could be fairer or more indulgent to your company than to take your own statements, and give you the opportunity of proving them. The worshipful the mayors or presidents of the chambers of commerce to be appointed umpires. Comparing other mechanical transmitters with that of the Bonelli Company, their inventors, using only one wire, claim far higher comparative rates of speed than the Bonelli Company, and yet it has not been found practicable to bring these apparatus into actual use. I refer the public to our proposals advertised in the *Daily News, Standard*, and *Telegraph* of the 26th, and *The Times* of the 27th of April. The public reading these will be enabled to judge which company desired a real *bona fide* trial. I would simply observe that this company is still prepared to

carry out the challenge given, and that, as we are much occupied just now in opening the large towns, a week's notice from you shall at any time find us ready to carry out this challenge, accepted by you, but now shunned. As regards the experiments you state that you are going to make, it has been open to your company to make them at any time since your line was erected, and that they are now again necessary is, I submit, proof sufficient that the public, best able to judge—viz., the telegraphing public of Liverpool and Manchester, has not encouraged the extension of the operations of your company. No more experiments that your company can make will satisfy the public, who can only be convinced by the results of an exhaustive trial to bring out the economical, mechanical, and electrical merits or demerits of the respective systems under the eyes of practical men fully alive to the commercial and practical merits of telegraphic systems, and thoroughly conversant with the economy and working of a telegraph company. You now decline to undergo the ordeal of such a trial, and until you are prepared to do so I must decline any further correspondence, and shall be perfectly satisfied to leave the public to judge between us.—W. ANDREWS, Secretary and Manager.—J. Gutteres, Esq.

MISCELLANEA.

TAR, A NON-CONDUCTOR.—A correspondent connected with one of our telegraph companies informs us that coal tar is a good non-conductor, and an excellent preservative for telegraph posts, but when applied cold it washes off. As it is difficult and inconvenient to apply it hot for such purposes, he desires us to call the attention of inventors to this subject, in order that they may make efforts to combine some other substance with it, so as to apply it cold and render it permanently adhesive.

TERRESTRIAL MAGNETISM.—Dr. Faraday has proved that all the phenomena of revolving plates may be produced by the inductive action of the earth's magnetism alone. If a copper plate be connected with a galvanometer by two copper wires, one from the centre and another from the circumference in order to collect and convey the electricity, it is found that when the plate revolves in a plane passing through the line of the dip the galvanometer is not affected. But as soon as the plate is inclined to that plane, electricity begins to be developed by its rotation; it becomes more powerful as the inclination increases, and arrives at a maximum when the plate revolves at right angles to the line of the dip. When the revolution is in the same direction with that of the hands of a watch, the current of electricity flows from its centre to its circumference; and when the rotation is in the opposite direction, the current sets the contrary way. The greatest deviation of the galvanometer amounted to 50° or 60° when the direction of the rotation was accommodated to the oscillation of the needle. Thus a copper plate revolving in a plane at right angles to the line of the dip forms a new electrical machine, differing from the common plate-glass machine by the material of which it is composed being the most perfect conductor, whereas glass is one of the most perfect non-conductors: besides, insulation, which is essential in the glass machine, is fatal in the copper one. The quantity of electricity evolved by the metal does not appear to be inferior to that developed by the glass, though very different in intensity.

THE THERMO-PILE OF SEEBECK AND MELLONI FOR MEASURING HEAT.—This instrument consists of a bundle of bars of bismuth and antimony, the single bars separated from each other by gypsum or some other non-conductor of electricity, but soldered together alternately at their ends. The two end-pieces of this so-called pile are connected with the copper wire of a galvanometer. Rays of heat impinging on one of the faces of the thermo-pile, develope in the latter an electric current, which during its passage through the copper wire deflects the magnetic needle of the galvanometer. An increase of the heat would augment the deflection of the needle. If we suppose our source of heat and its distance from the pile so chosen, that the radiant heat after passing through an exhausted tube would cause a deflection of 10° of the needle, then admission of an absorbing gas would cut off some of the rays of heat, and the needle would recede to a proportionate extent. We will assume the needle to point to $9\frac{9}{10}°$ after admission of air. A difference of $\frac{1}{10}°$ could scarcely be appreciated, and would therefore be a very doubtful result. The absolute amount of heat to cause the needle to move through an arc of 10° is very small. A more powerful flux of heat would increase the deflection and also the absorption. If we suppose the needle to have been deflected 81° by radiant heat passing through an exhausted tube, an absorption of 1 per cent. of this amount could scarcely be detected by retrograde movement of the needle, for it requires much more heat to move the needle from 80° to 81°, than from 9° to 10°; the galvanometer is more sensitive when the needle is near zero. Hence, if the instrument could be kept in this sensitive condition, whilst the substances to be examined are exposed to a very powerful flux of heat, the attending absorption might be detected. If the needle of the galvanometer is in its normal position, heat, which falls on one side of the thermo-pile, will always cause a deflection in the same direction; but if the heat is allowed to meet the opposite face of the pile, a deflection opposite in direction to the former will result. Therefore, if equal quantities of heat fall simultaneously on both sides of the pile, the effect produced by the one source will be counterbalanced by the equal effect of the other source, and the needle will remain at zero.

HEAT.—The application of heat to the various branches of the mechanical and chemical arts has, within a few years, effected a greater change in the condition of man than had been accomplished in any equal period of its existence. Armed, by the expansion and condensation of fluids, with a power equal to that of the lightning itself, conquering time and space, he flies over plains and travels on paths cut by human industry, even through mountains, with a velocity and smoothness more like planetary than terrestrial motion; he crosses the deep in opposition to wind and tide; by releasing the strain of the cable, he rides at anchor fearless of the storm; he makes the elements of air and water the carriers of warmth, not only to banish winter from his home but to adorn it even during the snow storm with the blossoms of his spring; and, like a magician, he arises from the gloomy and deep abyss of the mine the spirit of light to dispel the midnight darkness.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good	2/2 to 2/6 per lb.
Good re-boiled	1/6 to 1/8 „

INDIA RUBBER.

Para, first quality	1/10 to 1/11 „
second „	1/7 to 1/8 „
third Negro-head	1/2 to 1/3 „
Java and Penang	1/4 to 1/5 „

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	99 to 102	—
100	Submarine Telegraph, scrip. .	all	48 to 58	—
all	Do. registered	all	[illegible]	—
5	United Kingdom Telegraph .	3	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
Quarter ditto	1	7	6
Four lines and under (single column)	0	3	0

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

THE TELEGRAPHIC JOURNAL.

VOL. I. No. 20.—MAY 14, 1864.

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TELEGRAPHIC COMMUNICATION BETWEEN INDIA AND AUSTRALIA.

THE success which has attended telegraphic operations in the Persian Gulf has again revived the important subject of telegraphic communication to Australia. From the "Copy of Correspondence and Papers relating to the Establishment of Telegraphic Communication between India, Singapore, and Australia," recently printed by order of the House of Commons, a considerable amount of information will be derived upon the subject. It appears that Mr. F. Gisborne, who in 1859-60 went to Australia on the behalf of the promoters of the Anglo-Australian telegraph, made considerable progress towards the realisation of the great and desirable project, so far, that several of the colonies voted subsidies amounting to some £25,000 per annum, and further steps were taken to complete the amount to £35,000, and to set the undertaking on foot; but, however, owing to the failure of the Red Sea lines, and the incomplete state of telegraphic communication from Constantinople to Bagdad and Bussorah, and from thence to Kurrachee, the promoters of the Anglo-Australian telegraphs were deterred from proceeding further in the matter; and besides, the decision of the Government to change the destination of the then newly manufactured Rangoon and Singapore cable placed additional difficulties in the way of the promoters.

The proposed line is of considerable length, as will be found from the following measurements, and consist almost entirely of submarine links:—

	Nautical Miles.
Rangoon to Mergui	400
Mergui to Penang	400
Penang to Singapore	360
Singapore to Cape Sedano	1,160
Cape Sedano to Timor	590
Timor to Port Essington	525
Port Essington to Cape York	625
Cape York to Cleveland Bay	619
Cleveland Bay to Moreton Bay	655
Moreton Bay to Sydney (land line)	600

Captain Denham, of her Majesty's ship Herald, in reporting the result of his survey of the proposed line from Cape Sedano, in East Java, where the Dutch line from Singapore terminates, to Cape Cork, states:—"Nothing could be more favourable for an electric cable-bed than the depth and bottom of the Arafura Sea (17 to 50 fathoms very gradually and upon mud), until you get abreast (17 miles distance) of Cape York. * * * A cable might be laid in-shore of my track connecting Java with Timor by a line down Baly Strait, where I found 282 fathoms up sand; then along the southern-face offing of Landbach, Sombara, and Flores, to Koepang; then by land to the north-east extreme of Timor; whence and oblique east by south submarine direction across the Arafura Sea by Cape Wessel to Cape York, or a station upon the eastern side of Cape Carpentaria, where your Excellency's Government would consummate the enterprise. This would comprise 1,600 miles of distance, and require 2,000 miles of cable between Australia and Java."

As it is our intention to refer to the contents of this important Parliamentary paper in our next number, we extract the following statement made by the promoters, and submitted by them to the Colonial and Home Governments:—

The objects of the promoters, who represent forty banks and firms trading with China and Australia, are to establish telegraphic communication between India and Australia, and between India and China, the effect of which will be to bring Australia and China into nearly instantaneous communication with India and with each other, and within, say, sixteen days of Great Britain, besides converting the communication, which is now once a month only to Australia and once a fortnight to China, into a weekly one to each country. When telegraphic communication is re-established between Egypt, or Turkey in Asia, and India, the communication between Great Britain, China, and Australia will be further reduced from sixteen days to about as many hours.

To carry out these objects, it will be necessary to construct three lines of telegraph:—

1. To lay a submarine cable to connect Singapore with the telegraph system of India at Rangoon, the present terminus of that system, over a distance of 1,200 sea miles, with intermediate stations at Amherst (Moulmein), King Island, and Penang.

2. To extend the cable from Singapore to Hong Kong (Canton), viâ Sarawak, Labuan, and Manilla, a distance of 2,080 miles, or viâ the French settlement of Saigon, a distance of 1,678 miles.

3. To extend the Dutch lines which connect Singapore with Batavia and the east end of Java, from that point to the terminus of the telegraphic system of Australia, which at present is at Brisbane, on the eastern coast, but which is likely to be soon carried further northward.

The distance from Java to Brisbane, viâ Timor and the Northern Coast of Australia, is 3,024 miles.

Soundings have been taken between Rangoon, Singapore and Hong Kong, also between Java and Brisbane, and they show that the different cables can be laid on a soft and uniform sea-bottom, seldom exceeding 50 fathoms in depth.

The numerous islands of these seas will enable stations to be placed about 600 miles apart—a convenient distance for working and repairs.

The Malta and Alexandria cable, which is longer than the proposed India-Singapore, and nearly half the length of the Java-Brisbane line, in common with nearly every other cable laid in shallow water, or say within 100 fathoms, has been maintained in permanent good working order. At this moment there are more than 3,000 nautical miles of cable, containing upwards of 5,000 miles of insulated wire, successfully at work in shallow water; some have worked for eight or ten years, and a large proportion have cost nothing for repairs. Occasional interruptions are the only dangers to be feared; and when an efficient steamer is maintained for the purpose, any necessary repairs can be rapidly and easily effected.

The promoters have applied to the Government of India for an annual subsidy in support of the India-Singapore, or first section. Sir Charles Wood assured a deputation of the promoters that the Indian Government would carry out, or assist in carrying out, this section contemporaneously with the other sections.

They have applied to the Government for an annual subsidy for that portion of the second section which is between Singapore and Saigon.

The Australian Legislatures voted considerable subsidies two years ago in support of the Java-Queensland, or third section, and they have been asked to apply them to carrying out the work at once.

All these subsidies are only to run during the successful working of the lines; but a reasonable time in each year is to be allowed for repairs, without any deduction in the payments. The Company will always have a steamer in readiness to effect any repairs which may be required.

The Singapore-Batavia line has been frequently interrupted. These interruptions have been due partly to the light cable used, and have been unnecessarily prolonged, owing to the absence of any organization for repairs; but the Dutch Government will have a strong interest in keeping up this telegraphic communication efficiently, so soon as Singapore is connected with India. They have granted the right to the promoters to have a separate wire through Java, and to settle the tariff of messages in conjunction with the Government.

Arrangements are in progress for securing an efficient cable between Batavia-Singapore.

It appears from official returns that 10,000 vessels, including repeated voyages, and a trade of £64,000,000 at the least, will annually make use of the line between India and China, and that a trade of £40,000,000, in which 2,400 vessels are engaged, will annually make use of that between India and Australia. The trade, moreover, both with China and Australia, is rapidly on the increase, and a large and wealthy population in the latter country will send and receive numerous messages on private business. From

these sources it is estimated that a minimum of 40,000 messages will be annually transmitted by the cable between India and China, and a similar number by that between India and Australia, principally on their way to and from Europe, being 55 messages per diem each way to and from China and Australia respectively.

The relative cost of the three sections will be as follows:—

Rangoon-Singapore	£450,000
Singapore-Hong Kong	530,000
Java-Brisbane	1,100,000
Total	£2,080,000
Singapore to Java (subsidy of £8,500 per annum given by Dutch Government)	170,000
TOTAL	£2,250,000

This capital includes a sufficient reserve fund, and will provide heavy cables, protected against corrosion by a hard bituminous outer covering. The cables will be capable of transmitting over 70,000 messages, of twenty words each, per annum, with the ordinary instruments now in use. For the India-Singapore section a larger core will be adopted, capable of transmitting 150,000 messages per annum. This number of messages could be doubled by adopting the latest improvements in instruments.

The negotiations between the promoters and the Australian Governments, in reference to the line between Java and Queensland, have been carried on as follows:—Mr. F. Gisborne proceeded to Australia in 1860, for the purpose of obtaining subsidies for that line. New South Wales voted a subsidy of £10,000 per annum, without requiring the Home Government to contribute. Victoria voted £13,000 a-year, contingent upon the Home Government contributing something; and the Governments of Tasmania, New Zealand, and Queensland promised proportionate contributions. Subsequently Victoria made an offer to the Home Government to provide half of the whole subsidy that might be required, if the Home Government would also provide half. It was understood at the time that Victoria would take Tasmania, South Australia, and Western Australia as her co-contributors, leaving New South Wales, Queensland, and New Zealand as co-contributors with the Home Government, which would practically reduce the contribution of the Home Government to a trifling amount. The whole annual subsidy then asked for was £35,000 to raise a capital of £800,000. This was calculated to provide a cable similar to that then recently laid in the Red Sea, and between Batavia and Singapore. The outer iron covering of this cable, however, has since proved very much too light, and liable to corrosion. The greater part of the Red Sea cable was laid in deep water, where it was impossible to repair it. The failure of this and other deep sea cables made it impossible for some time to act upon the resolutions passed by the Australian Legislatures. The public did not at first discriminate between deep and shallow sea cables, but the obvious and continued success of the great majority of shallow sea lines, and especially of the long cable between Malta and Alexandria, has revived public confidence in those undertakings. It is now proposed to lay a cable three and a half times the weight of that laid in the Red Sea, and moreover, protected against corrosion by a hard bituminous outer covering, which has been successfully applied to cables in the English and Irish Channels.

To lay this heavier cable, it will be necessary to increase the capital to £1,100,000. The subsidy would thus be raised to £50,000 per annum, on the basis already adopted in the resolutions passed by the Legislatures of New South Wales and Victoria, in 1860.

The subsidy is to run for thirty years. The promoters offer to transmit the messages of the Colonial and Home Governments without payment to the extent of the subsidy, and in case the Home Government does not contribute, to place the tariff value of their messages to the credit of the subsidy, so that the difference only should be paid by the Colonies. It is estimated that 40,000 additional messages will be brought annually upon the telegraphs in Australia by the subsidised line, which will be a considerable source of revenue towards paying the subsidy.

The promoters ask that Victoria and New South Wales shall render themselves liable to the Company for the whole subsidy. The liability will be equitably redistributed by means of an intercolonial agreement, basing the contribution of each Colony towards the whole subsidy on the use it shall make of the subsidised line. Thus, if Victoria sends and receives half of the whole number of messages transmitted through that line in any year, it would pay the half of the subsidy. The payment of the subsidy is to be contingent upon the successful working of the cable. Should the Government of Queensland extend its telegraphs to a point north of Brisbane, for instance, to Broad Sound, the Company's cable might be made to terminate at such point; but any such extension must be completed by the end of 1864, and will not diminish the number of stations or the total working expenses, though it will save 350 miles of sea line.

The cable between Java and Brisbane could be laid in about two years after the letting of the contract.

It is proposed to give the Colonies an efficient control over the tariff. Under existing arrangements no tariff can be established anywhere between Malta and Java, without the assent of the British Government.

As regards the contribution of the Home Government, it should be borne in mind that her Majesty's Government has bound itself to complete the telegraph lines as far as Singapore, and will no doubt assist the telegraph to Australia, by lending ships to take additional soundings, and to pilot the cable expedition. It should also be remembered that only one-fifth of the line, the section, namely, between Java and Timor, is out of Australian waters.

LEWIS'S PERMUTATING TELEGRAPH SWITCH.

IN central or way telegraph offices, where any considerable number of different lines or wires have their termini, it is frequently necessary to place the various conductors in communication, so that messages may be continuously transmitted from one city to another without stoppage or re-writing at the central office. This union is generally effected by means of a "switch," which consists of a pivoted bar of metal, so made that on being properly turned it will form a conducting medium to bring a pair of wires or lines into electrical communication.

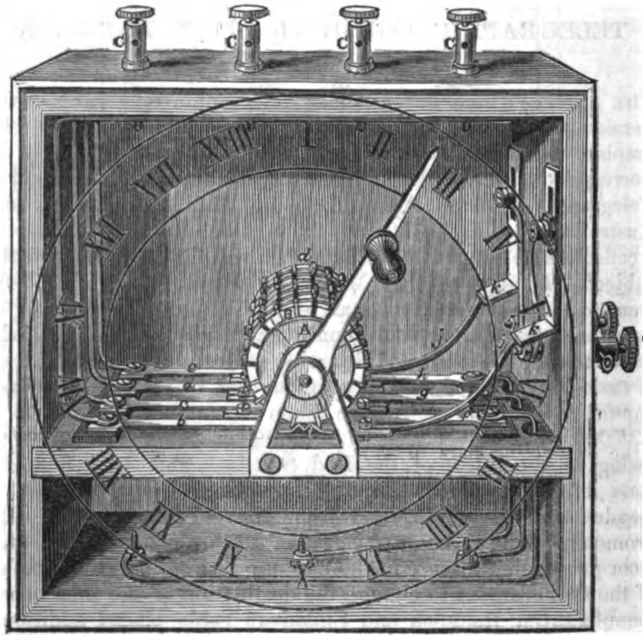


FIG. 1.

Our engravings illustrate a very ingenious improvement by which a single instrument may be made to serve the useful purposes of a large number of the ordinary switch devices. A is a small cylinder of some non-conducting material. Extending across its surface, fastened in grooves, is a series of conducting or connecting bars, B, having teeth, *a*, projecting from them, as shown in Fig. 2. The termini of the different wires or telegraph lines are made in the form of flat springs, *b*, *c*, *d*, *e*, *f*, *g*, *h*, and they are arranged directly under the cylinder, A, towards which they press. In our engraving the springs at the left are attached to the wires which extend up to the screw cups, C, upon the case. The springs at the right pertain to wires that lead below to screw cups under the case, and may connect with the relay instrument, sounder, ground plate or battery.

It will now be apparent that the several springs are, practically,

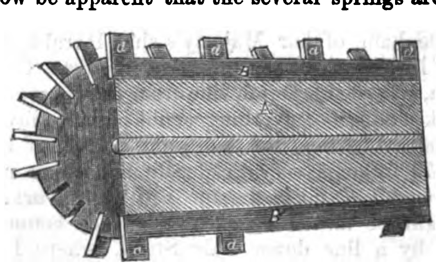


FIG. 2.

so many terminations of electrical conductors or telegraph wires, and the several bars, B, serve to form connections between the said

wires, for the electric fluid will pass along the bars, B, from one spring or wire to another. The bars, B, having been suitably arranged on the surface of the cylinder, may be made to make any desired connections between two or more of the springs. These connections may be established or changed by rotating the cylinder, so as to bring a new bar into contact with the springs. The cylinder is rotated by means of the pointer which traverses a dial face upon the exterior of the instrument. Each number upon this dial indicates to the operator a certain pre-arranged set or combination of connections between the springs. If, for example, the pointer is set at III. it may indicate that wires between New Haven, Philadelphia, and Albany are connected; if the pointer

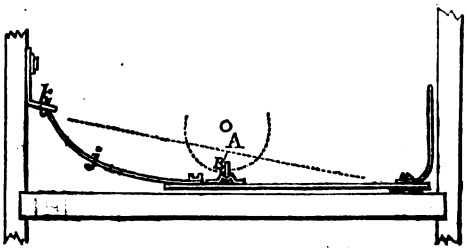


FIG. 3.

is now moved to VI. the cylinder is also turned, and a new connecting-bar, B, is brought into contact with the springs, which may connect the wires between New York, Boston, Washington and Buffalo, and so on. The number of permutations of which a small instrument like this is susceptible is very great, and its extensive utility must be obvious. These permutations may be increased by enlarging the cylinder or by employing two or more cylinders in the same instrument.

The springs are provided at *i* with notches to receive the teeth of the connecting bars, as shown in Fig. 3. The notches serve to hold the cylinder in whatever position it is set by the operator; but the pressure of the springs against the teeth is not great, consequently the cylinder may be readily changed in its position, by moving the dial pointer. The friction of the inclined sides of the notches, *i*, keeps the parts always bright. The several extremities of the springs are forked, and in the fork of each there is a screw stop, which serves as a guide and also prevents the springs from rising too far; contact with the cylinder, when it is so turned that none of the springs are acted upon by the projections, *a*, is thus prevented.

The length of the springs may be increased, if desirable, by the attachment to them of curved parts, *j j*. The extremities of these curved parts press against the under side of the metallic plates, *k*; and these plates are connected to wires leading to any desired screw cup. Two examples of this mode of extending the springs are shown at the right, in the engraving. See also Fig. 3.

The inventor claims:—1. The cylinder and the connecting bars, or their equivalent devices. 2. The springs acting against the barrel. 3. The alternate arrangement of the springs. 4. The notches, with inclined edges, upon the springs. 5. The mode of limiting the upward movement of the springs. 6. The combination of the cylinder with its connecting bars, and the springs with the dial and pointer. These constitute the principal features of the invention, as illustrated in our engraving; and they appear to be very broadly covered by the patent.

This invention has been patented by James Lewis, who may be addressed for further information at Mohawk, Herkimer county, N. Y.—*Scientific American.*

ELECTRO-MAGNETIC PENDULUM.—The principal object of the inventors, Messrs. Hamblet and Edwards, of Boston, U.S., is to apply the pendulum power obtained from an electro-magnet, in order to maintain and also, if desired, to initiate its motion without subjecting it to the direct attraction of the magnet, or in any way attaching to it an armature or fixed magnet, or any piece of metal subject to the attraction of a magnet. The invention consists chiefly in the employment of wedge-shaped pallets in combination with the armature of the electro-magnet, and with one or more impulse bars and springs, whereby the above result is obtained. It also consists in so applying the said pallets in the circuit in which the electro-magnet is placed, that the opening of the circuit, to produce the necessary intermissions of the current, takes place between the said pallets.

THE PROPOSED COMPETITION BETWEEN THE HUGHES AND BONELLI INSTRUMENTS.

WHENCE emanated the advertisement we noted in the daily journals, awhile ago, announcing:—

CHEAP TELEGRAMS.—A Company is in course of formation to establish an uniform sixpenny rate for telegraph messages, &c.

and promising further particulars in a few days? It has disappeared from the public prints, leaving us in expectancy, and we confess somewhat disappointed at not being able to record a further step in telegraphic progress. It is a curious coincidence, however, that this announcement succeeded, day by day, the advertisement of the Bonelli Company, and was withdrawn simultaneously with the prospectus and form of application for shares in this company. Many persons would be led to believe that this was a *ruse* to create perplexity in the minds of capitalists, and to retard investments in telegraph shares, and especially in those of a new company. If the public is wrong in these conjectures, it will be glad to make the *amende honorable,* on receiving the "further particulars," now long promised.

The advent of the Bonelli Company does not appear to have been received kindly; on the contrary, inventors, manufacturers, and would-be authorities on electrical science were all prepared to prove something that would militate against the success of the project, or else they knew of instruments that would surpass Bonelli's in every particular. The managers of the United Kingdom Telegraph Company appear to have been terrified out of their propriety, and in their determination to nip the new enterprise in the bud, they rushed into print again with their prospectus, resorted to every kind of unavailing opposition, and consummated their folly by throwing down the gauntlet to the telegraphic aspirant to public favour. The form of challenge is immaterial to our present purpose, but as it evinces so large a proportion of assurance, we publish it in this place:—"The Directors of the United Kingdom Company challenge the Bonelli Company to a competitive trial of the system they propose with the system of the United Kingdom Company, between London and Liverpool, and are prepared to prove the Bonelli system, wire for wire, to be slower, infinitely more costly, and from the number of wires required, impracticable." We hardly know whether the directors of the Bonelli Company deserve to be censured for precipitancy, or commended for ingenuousness in accepting this challenge, without having the conditions of competition submitted beforehand; because the framing of a series of rules to be observed in these cases often presents a favourable opportunity for the braggadocio (whether it be an individual or a corporate body) to skulk away when brought to deliberate on its own propositions. The competition, nevertheless, was decided upon, and was to have been commenced upon the lines between Liverpool and Manchester on the 30th ult., but owing to a series of decidedly one-sided propositions having been submitted by the United Kingdom Company, disagreement arose, further correspondence ensued, and delay has resulted. It is to a consideration of these proposals that we intend to devote a little space.

A fair field and no favour is an axiom which obtains in all *rencontres* in which Englishmen engage, and the competition for superiority in the rates of transmission of telegraphic messages must not be an exception to this very excellent law. What then are the conditions insisted on by the United Kingdom Company, for a trial of their systems against the apparatus used by the Bonelli Company? The trial is to be of such a character as to afford really satisfactory evidence of the merits of the respective processes. Well and good. But who is to receive the evidence, witness the experiments, and adjudicate thereon? This question has not been lost sight of by the astute framers of this code, so we find that the Worshipful the Mayors of the aforesaid towns, or the Presidents of the Chambers of Commerce, are to arrange the details of the work to be performed, and to record the results. A very general notion prevails among the educated classes of the community that persons who study the law are better qualified to interpret Blackstone than successful manufacturers of cotton fabrics, or ship-brokers; that those who devote themselves to science are more likely to appreciate the value of scientific research than millionaires; and that engineers are far better able to report upon the nature of any new invention, than others, however lofty their stations, who have paid but little attention to mechanics. We are simple enough to entertain these convictions ourselves, and with all deference to the functionaries whose services are to be put into requisition, are disposed to question the wisdom of the

selections, and to suggest that it would be possible to find a more competent tribunal. It seldom happens that men of science aspire to municipal dignities, and we fear that Mr. Fairbairn (an exception to this rule) would experience the greatest difficulty in finding a coadjutor to his mind among the civic authorities of the queendom. But to proceed: the trials are to be exhaustive, to extend over a period of fourteen days, in all weathers, and, had not delay occurred, were to have been commenced, as before stated, on the 30th April; so we are led to conclude that arrangements had been made with Admiral Fitzroy, for samples of "all weathers" during the period extending from that date to the 13th instant, and certainly, to the present time, the meteorological variations would warrant such an assumption. It is also required that the messages to be sent by both companies, during the trial, shall be *fac similes*. Now, if language conveys any idea at all it is this, that the Bonelli Company is to have a fount of type cast of the same character as that used in Hughes' machine, especially for this competition, a requirement positively preposterous; indeed, so absurd that we incline to the view that the challengers, in their enthusiasm, hardly know what they mean; hence we interpose the suggestion that, instead of all messages being fac similes, they are only required to be verbally identical. When we come to consider the instruments to be employed, and the plans by which it is proposed to estimate the work performed by the several instruments, we are favoured with a lesson in arithmetic untaught by Walkinghame. "As the United Kingdom Company uses for both the Hughes Printer, and the Morse Ink-Writer ["for with *both* of these" says the manager, "will the challenge have to be worked out"] only *one wire* EACH, the results in every case be *multiplied by five* for work performed and cost of performing it, so as to *equal* the *five* wires used by the Bonelli Company," *i.e.*, the United Kingdom Company require that the work of five Morse and five Hughes instruments, with ten wires be allowed them to compete with one of Bonelli's instruments, because in working the latter it is necessary to use five wires. The utter absurdity of the proposition elicited a rejoinder, but it should have served to convince the Bonelli Company that the matter of this challenge, unless given for ulterior purposes, has been a very silly joke from beginning to end. We are inclined to the latter opinion, because in the last announcement of the United Kingdom Company it is plainly stated that these propositions are, like the laws of the Medes and Persians, unalterable, and that if the Bonelli Company do not accede to them, further correspondence will fail to effect any settlement of the claims in dispute.

There are several features in this discussion which must not be passed unnoticed. The inuendoes contained in some of the propositions call for serious animadversion. What have the basis performances of the apparatus, *published in the prospectus of the Bonelli Company*, to do with the merits of the several inventions to be put on trial? Why is this Company to declare its available capital, the amount to be paid for patent right, and other remote particulars? What purpose can be accomplished in the course of the trial by the Bonelli Company showing where its instruments are employed in France? These are matters which the directors of the said Company are prepared, doubtless, to lay before their shareholders at the proper season; but how they can affect the merits of the several inventions, or how, by this information, the United Kingdom Company intend "to prove the Bonelli system, wire for wire, to be slower, infinitely more costly, and from the number of wires required, impracticable," we are at a loss to divine. This controversy was initiated by the United Kingdom Company, and before any practical result has been arrived at, we are naïvely informed by the manager of this Company that, as the Bonelli Company desire more equitable terms for the proposed competition than those submitted, and as he has other business on hand, he he must decline further correspondence, and will be perfectly satisfied to leave the public to judge between them. We can only express our regret that so much valuable time has been lost by the disputants, which might have been profitably employed in furthering the interests of the respective companies, and in meeting the requirements of the public. It is truly pitiable to behold a man, unbereft of reason, resorting to mean artifices to accomplish selfish designs; and it is with kindred feelings that we have witnessed the puerile attempts of the United Kingdom Company to retard the introduction of improvements in the art of electro-telegraphy, because they may probably at some future time affect its interests.

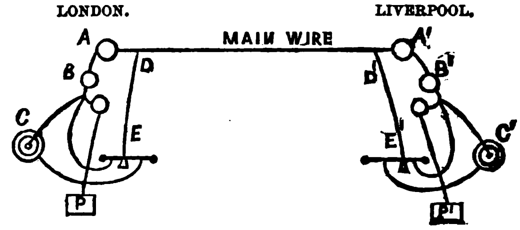
L. M.

[We cannot endorse all the opinions expressed by our contributor.—ED. T. J.]

THE SIMULTANEOUS TRANSMISSION OF MESSAGES OVER A SINGLE WIRE IN OPPOSITE DIRECTIONS.

CONTRIBUTED BY G. B. PRESCOTT, ESQ.

THE transmission of messages over a single wire in opposite directions at the same instant, had occupied the attention of the scientific, both in Europe and America; and the problem has been solved, in as many different ways, by no less than five individuals. The following drawing illustrates the method devised by Dr. Gintl, of Germany, which seems to be very simple, and proves, upon trial, to work with entire success.



The apparatus used is that of Professor Morse. The arrangement of the circuit is that technically known as the open circuit.

Let me premise that in transmitting a dispatch by this system, the electro-magnet of the transmitting station does not work—only that of the receiving station is operated by the current. When the key, or transmitter, is at rest, a spring closes the connecting point at the back end, and when it is pressed down by the operator in transmitting a message, the back connection is broken, and the front one established.

I have represented a section of line between London and Liverpool. A, A', are two rheostats in the offices of London and Liverpool, which represent, each of them, the exact resistance of the line wire between these two points. B, B', are electro-magnets of peculiar construction, being so arranged that a current may traverse either half or the whole of the coils, or may traverse one coil in one direction, and the other coil in the opposite direction. C, C', are the batteries; E, E', the keys; and P, P', the ground plates.

Let us now suppose that London wishes to send to Liverpool. The operator at London presses down his key, and the current from the battery, C, passes through the key to the main wire, and thence down the branch wire, D', through the key, E', to magnet, B', thence through the ground plates, P' and P, to the magnet, B, and thus back to its starting point in the battery at C. When the current passes through the coil, B', at Liverpool, it operates the apparatus there in the usual manner. But I have not described the entire course of the current. When it reached the junction, D, one half of it passed through the rheostat, A, through the upper half of the magnet, B, and thence to its starting point at the battery. It will thus be seen that one-half of the current having passed in one direction through one of the coils, B, and the other half in the opposite direction through the other coil, B, B', that its effect is neutralised, and that no action takes place in the magnet at the transmitting station.

Now let us suppose that London and Liverpool both press their keys down at the same moment, each sending to the other. The current from the batteries, C and C', would meet at the junction, D and D', and neutralise each other, and, consequently, no current would pass over the wire. It would, in fact, be the same as if the wire were actually broken between these points during the time that both keys were pressed down. Under these circumstances the current from the battery, C, returns through the rheostat, A, through one-half of the coil, B, and thence back to the battery, C. What takes place at London, of course occurs at Liverpool under the same conditions. Thus the writing upon the London and Liverpool instruments is actually performed by their own respective batteries, but as this record depends upon the closing of the key at the distant station, it amounts to the same as if done by the battery of the other.

Having now shown how the record is made while the receiving station has his key in its ordinary position of rest, as well as where it is pressed down in the act of transmitting, let us now consider what will be the course of the current when it is in neither of these positions, that is to say, when the back connection has been broken by pressing the lever to make a letter, but before the front contact

has been established. We will consider that Liverpool's key is in this position, and that London is writing. In this case the current, on arriving at D′, does not pass down the branch wire, as there is no outlet for it, but passes on through the rheostat, A′, thence through both coils, B′, to the ground plate, F′. The current in this case, passes not only along the line between London and Liverpool, but also encounters a resistance at A′, of equal extent; but this is equalised by passing through both coils of the electro-magnet, B′, so that the adjustment of the instrument remains the same throughout.

If this apparatus has not been generally used, it does not arise from its inutility. With a line well constructed, and properly insulated, there would be no difficulty in working it. It could not be relied upon where there is heavy escape, and to have entire success the resistance coils should exactly equal the resistance of the line wire, and the magnets be well constructed.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 223.)

5. *Instruments employed in the production of Statical Electricity.*

C. F. Varley, M. (United Kingdom, 2,981), exhibits an instrument by which very feeble electrical tensions may be multiplied several thousand-fold, so that by its use the tension of the feeblest electrical sources may be demonstrated, and sparks or other analogous phenomena developed from a tension no greater than that produced by the single voltaic cell.* The instrument might be called a multiplying inductor. It consists of an axis on which parallel rows of insulated brass vanes or arms are fixed; the description will be simplified by considering one row of vanes only, A, B, C, D, &c. The axis may be turned by hand, and at two points of the revolution, diametrically opposite to each other, the vanes enter two rows of hollow insulated coverings or shells of brass, a_1 a_1 a_2 a_3, &c., and b_1 b_{11} b_{21} b_3, &c. These shells conceal the vanes entirely on three sides, and are connected one with another as follows: a unconnected, a_1 a_2 joined together, a_3 a_4 joined together, a_5 a_6 joined together, &c. In the opposite row, b b_1 are joined, b_2 b_3 joined, b_4 b_5 joined, &c.; a is opposite b, a_1 opposite b_1, &c. Thus the two rows may be said to be arranged in alternate insulated couples.

The charge to be multiplied is communicated to a, and we will first suppose this charge to consist of a certain definite quantity retained without loss by means of perfect insulation. The axis is next turned round by hand; when the vane A is inside a, an earth connection is made at the inner end of the vane A, where it is not covered by the shell. If the charge on a be positive, a negative charge of corresponding magnitude will be induced on A. The charge so induced may approach more or less nearly, according to the proportions of the instrument, to equality with the charge on a; it will always be somewhat less, but can easily be made in practice to differ very little from the original charge. When the axis is turned round still further, the earth connection is broken, and the negative charge remains insulated on the vane A. As the axis continues to revolve, the vane A is brought inside the shell b, and is then put in connection with the shells b b_1 by a suitable contact. The negative charge on A will then almost entirely distribute itself over the outer surface of the double shell b b_1. As the axis is turned round and round, the same series of contacts will be repeated, successive charges on A will be induced by a and communicated to the double shell b b_1, on the surface of which these charges will gradually accumulate, tending towards a limit which is only not infinite (leaving insulation out of consideration), because, when the vane is inside b b_1, and its contact there made, its whole metal is not surrounded by a closed metal surface forming part of b. The effect will, however, practically be limited rather by imperfect insulation than by the want of continuity in the surrounding surface of b b_1. But while negative electricity is thus accumulating on b b_1, the second vane B has been continually passing through the shell b_1. At the moment when fully covered by this shell, an earth contact has been made with this vane, as already described for vane A. B has therefore been receiving continually greater charges of positive electricity, each very nearly equal to the quantity of negative electricity at that time on b b_1, and these in their turn it has communicated to the shells a_1 a_2. The vane C receives continually-increasing negative charges from a_1 a_2, which it communicates to b_2 b_4, and thus the multiplication proceeds through any required number of vanes and shells by the simple process of turning the axis.

* Professor Wheatstone has pointed out to the writer, that in 1787 and 1788 instruments designed to fulfil the same object were described by Bennett and Nicholson in the "Philosophical Transactions."

If all the vanes and shells be alike, and if one vane with its pair of shells can at most produce a charge in the second shell only ten times greater than that in the first, it is clear that ten vanes and their shells would produce a maximum charge in the final shell 10^{10}, or 10,000,000,000 times greater than that on the first shell. The tension of this final shell, if all disturbing causes be removed, would likewise be 10,000,000,000 times greater than that of the first shell under similar circumstances. Metallic screens in connection with the earth are used between each pair of coupled shells to prevent their action one on the other, and also surrounding the whole apparatus to screen it from irregular electric induction.

If, instead of giving the first shell a a certain definite quantity of electricity, it were maintained at a certain constant potential by contact with a source of electricity (for instance, connected with one pole of a battery, while the other is in connection with the earth), the result would be exactly similar to that which would be obtained if a definite quantity, equal to that contained in the shell a when the vane A is inside it, and the earth contact made, had been communicated to the shell a in the first instance. The actual multiplication for each number of turns would, when the insulation is good, be perfectly definite, but could in this arrangement be practically determined by experiment only; it was understood that Mr. Varley has, by slightly modifying the present arrangement, produced an instrument in which it is easy by calculation to determine the multiplication given by any fixed number of turns.

Peclet with his three-plate condenser has long since given a means by which electrical tensions might be indefinitely multiplied, but the manipulation of his instrument was extremely tedious, and its action notoriously irregular. Svanberg in 1848 described to the British Association a superior arrangement to Peclet's, with which he states that he actually obtained sparks from a single Daniell's cell. The manipulation of Svanberg's apparatus would, however, be very tedious, and unless special precautions were taken in making the successive connections by hand, the results could not be relied on. Mr. Varley's apparatus is extremely simple in its use, and substitutes simple rotation for the complicated series of transfers required by Svanberg and Peclet; it is consequently much more rapid in its action, and on this account alone more certain; all the contacts are made mechanically, and are therefore always made in the same manner; and Mr. Varley so constructs his instrument that the contacts shall always take place between exactly similar pieces of platinum. As a proof that the instrument could be relied on as indicating a real multiplication of the charge originally given to the first plate, Mr. Varley showed the jury a strong positive tension, produced by multiplying the tension of the positive pole of a Daniell's cell by a definite number of rotations of the axis, and then reversing the poles of the battery and turning the axis of the instrument double the number of times used to produce the first tension, he reversed that tension, and produced a very nearly equal tension of the opposite sign. The tensions were strong enough to produce sparks, and were measured on Professor W. Thomson's portable electrometer, exhibited by Mr. White. Mr. Varley has since informed the writer that he has obtained a multiplication of more than 15,000 times the original tension by the use of his instrument. It should be observed that this instrument offers an instance of the direct transformation of work into electrical distribution.

C. Varley (United Kingdom, 2,980) exhibits a fine electrical machine with a vulcanite disc, and with conductors mounted on vulcanite stems. This application of vulcanite is novel since 1851, and gives excellent results, allowing the apparatus to be satisfactorily worked in damp states of the atmosphere, when instruments made with the common glass mountings would be nearly useless. The disc of vulcanite is thirty-five inches in diameter. The amalgam used with this material should be softer than that used with glass, otherwise the disc deteriorates with use. A large induction ring is used on the plan adopted by Dr. Winter, of Vienna. Under favourable circumstances sparks twenty inches in length have been obtained from this instrument. Without Dr. Winter's ring the sparks were reduced to about seven inches.

Elliott Brothers, M. (United Kingdom, 2,897), and S. W. Silver & Co., M. (United Kingdom, 2,960), also exhibit large and good electrical machines with ebonite or vulcanite discs and mountings.

H. Watson, Newcastle (United Kingdom, 2,986), exhibits an Armstrong's hydro-electric machine of the usual form.

6. *Chronoscopes.*

Chronoscopes, or instruments used for the measurement of very short intervals of time, will next be considered. As already mentioned, these instruments are chiefly used for determining the velocity of projectiles. Two screens, made each of a continuous wire led backwards and forwards across a frame, are placed in the path of the ball at a known distance apart. The wires of each screen form part of complete circuits communicating with the instrument; when the wires are successively broken by the projectile the successive interruptions of the two circuits are registered by electrical means on some apparatus, part of which moves with a known velocity. This plan of determining the velocity of a ball is due to Professor Wheatstone.

It is not necessary that the two circuits should be distinct throughout their whole length; the rupture of the circuit containing the first screen by the very cessation of the current through it is easily made by electro-magnetic apparatus, to establish a current through a circuit containing both the second screen and part of the first circuit. By these very simple contrivances, the ball as it successively breaks two circuits, sends as it were two signals by stopping two currents at the very instant that it passes two points of the trajectory, but it is by no means equally easy to *register* the instants at which those signals are sent. The time elapsing between them must be measured by reference to some continuous movement of which the speed is accurately known, and it is very difficult to produce such a movement. Clock-work governed by an escapement can only give a step-by-step or intermittent motion, and no frictional governor hitherto used can be depended on to produce perfect regularity. A second difficulty arises from the fact that no electro-magnetic effect is absolutely instantaneous, and that especially the effects on soft-iron cores, such as are frequently used in recording apparatus, are extremely uncertain or variable, so that an electro-magnet cannot be depended on to release or attract an armature at constant intervals after a given current is stopped. No doubt if every circumstance attending every experiment could be maintained rigorously the same, the electro-magnet would act constantly in one way; but in practice this cannot be effected.

M. Gloesener proposes to overcome this difficulty by using the deflection of a light galvanometer needle to register the cessation of the current, considering that although a certain time is doubtless required to produce even the smallest deflection, nevertheless the time will with equal currents be a constant quantity.

Dr. W. Siemens has used the spark from a Leyden jar to mark a polished metal cylinder, and so dispensed with all electro-magnetic gear.

M. Hardy at the suggestion of M. Martin de Brettes has, with the same view, used the spark from an induction coil to mark a small hole in paper; inertia is thus avoided, and very little time lost; but unfortunately sparks move very capriciously, sometimes darting to the one side and sometimes to the other, instead of going always in one direction. They sometimes, therefore, make their mark apparently a little too soon, and sometimes a little too late. The description of the apparatus exhibited will show how much talent has been exercised in the design and execution of these instruments.

E. Hardy, Paris, M. (France, 1,393), exhibits a chronoscope of excellent workmanship, and admirably arranged in most respects. It registers by means of an induction spark produced in a secondary circuit, by the rupture of the primary, and may be divided into the following parts for facility of description. 1st. A fixed brass cylinder, one metre in circumference, round which a band of prepared paper can be firmly stretched. 2nd. An axial arm of steel bearing a platinum point which revolves, describing a circle concentric with, and close to the cylindrical surface of the paper; this arm is driven by clockwork. 3rd. A pendulum revolving round a prolongation of the axis of the cylinder and driven by the axial arm, which presses against the lower end of the rod. This pendulum is intended to produce uniformity in the movement of the clockwork. 4th. An induction coil with primary and secondary circuits; one end of the secondary circuit is in connection with the point of the axial arm, and the other with the large brass cylinder on which the paper is stretched. The primary circuit is connected with a screen used as a target in the manner just described, and a current is allowed to circulate through it. The rupture of the screen, by interrupting the primary current, determines a spark in the secondary wire, registering the instant of the interruption by burning a small hole in the paper. By the armatures of a series of electro-magnets, the primary circuit can be re-established through a succession of wires and screens, giving a series of observations. Each interruption of the primary circuit is said to last about $\frac{1}{50}$th of a second.

Extraordinary care has been bestowed on every detail of this instrument; the wheels of the clockwork have all helicoidal teeth; by which great smoothness of motion is obtained; even the bevel wheels transforming the horizontal motion of the driving barrel into the vertical motion required for the axis of the conical pendulum have teeth cut on this principle.

The cylinder on which the paper is stretched can slide down along the axis; this motion is intended to allow a succession of observations to be made without stopping the instrument. If the series of observations follow each other rapidly, the cylinder simply slides down for a few seconds, restrained in its motion by a fly; but an arrangement is also provided by which, if required, the fly is only freed for a very little while after each spark, and then again locked, so that the observations may be continued for hours. With this view the clockwork is provided with hour, minute, and second hands.

The heavy conical pendulum is gimballed on four points in one plane, allowing perfect liberty of oscillation. Adjustments are provided, by which the centre of suspension of the pendulum is made to coincide with the axis of the cylinder, and levels are attached to the instrument, by which the verticality of the central axis can be insured.

A little ivory tube on the point from which the spark is discharged prevents in great measure any deviation of the spark from a direction normal to the surface. The paper is prepared with a solution of ferrocyanide of potassium, which allows the spark to produce a very small well-defined puncture, instead of the usual ragged hole.

The pendulum is about sixty centimetres long, and the weight of the bob twelve kilogrammes. This pendulum and the axial arm make about forty-five turns per minute, and one millimetre on the paper consequently represents the 45,000th part of a minute, or the 7,500th part of a second. A fraction of a millimetre could be easily observed; but such observations would not give trustworthy results, inasmuch as the random deviations of the spark amount occasionally to one third of a millimetre in spite of the little ivory guard. It is observed that the spark is not produced at the very instant that the primary circuit is interrupted; but M. Hardy can measure the time lost from this cause by using the radial arm to break the primary circuit at a certain point of its revolution, and observing the angular distance which separates this point from the little hole made by the corresponding spark; the time lost in this way is found to be very small, and tolerably constant.

M. Hardy finds by careful experiment with an astronomical clock that he can depend on the perfect uniformity of the rotation of his axial arm. His experiments not only showed that the same number of revolutions were made in each minute, but that each revolution was accomplished at a sensibly uniform speed; at least, any error which may have occurred was less than the error due to the spark—*i.e.*, less than the 3,000th part of the circumference, or the 22,500th part of a second. There is no reason to doubt the truth of these experiments; but the uniformity of motion must have been due to M. Hardy's excellent workmanship, rather than to any regulation afforded by the conical pendulum. The slightest variation of driving power or resistance during any revolution, such as would be produced by a little want of truth in any of the train of wheels, or imperfect coincidence between the axis of the pendulum and the axis of the driving arm, would have caused the pendulum to travel in an elliptical path with an uniform motion of the radius vector producing want of uniformity in the axial arm. M. Hardy himself states that he observed this very effect when he used common spur or bevel wheels. The pendulum, therefore, could not have been the cause of the uniformity of motion during each revolution. Neither could it have determined the equality observed in the number of revolutions per minute, except inasmuch as it acted as an air vane, meeting with greater resistance as it deviated further from the axis. It is true that the period of a conical pendulum is the same as that of a reciprocating pendulum of equal length and weight, and that this period does not sensibly differ for small angles of deviation; but the simple effect of any increased driving power on a conical pendulum is to make it at once deviate beyond these very small angles, and assume the position corresponding to the speed at which the frictional resistance of the clockwork balances the accelerating force of the driving weight. During the change of position it is true that the driving weight has to lift the bob of the

pendulum, and during this time meets with greater resistance from this cause; but when once the pendulum has assumed its new position it offers no more resistance to the driving weight than it did in its old position, except such additional resistance as may be due to its more rapid motion through the air. In a word, except from this latter cause, the pendulum in one position gives the driving weight no more work to do than in any other, and can in no way act as a restraining break. A slight advantage is gained by its resistance to being lifted on an increase of speed, and by the acceleration which it tends to produce when falling towards the centre after any slight decrease in the driving force. It is believed that no existing governor produces a perfectly uniform movement of rotation.

The whole of M. Hardy's instrument exhibits admirable workmanship, and it is suitable to a very large number of researches, in which the accurate measurement of small intervals of time is required.

(To be continued.)

ELECTRO-MAGNETIC INDUCTION MACHINE.

WE have had an opportunity recently of witnessing in operation a very ingenious and valuable apparatus for obtaining from a few voltaic pairs, by means of magnetic induction, a continuous stream of electricity in one direction. The machine is entirely self-acting, and consists of two induction coils. The internal coils are formed of No. 12 copper wire, and the outer coils of No. 18 copper wire. The cores of the shools are 1¼ inch in diameter, made up of annealed rods $\frac{1}{16}$ inch in diameter. The break is rotatory, with two five-toothed break-wheels, and springs bearing upon them tipped with platinum; rotatory motion is given to the break by a ratchet-wheel, with upper and under reverse clicks. The commutator is reciprocating. It has two contact cores and four contact ports. The contact cores are carried by a crosshead attached to the central reciprocating rod and armature. The contact cores are insulated from the crosshead by means of glass tubes and gutta-percha washers. Each contact core has each of its ends divided into two portions, the outer portions have glass tubes cemented into them, and the other portions have the metal turned down to the level of the glass tubes. These contact cores move in the induction ports, and they alternately rest on their glass and metal portions; consequently, are alternately insulated from, and in contact with, each pair of ports. The battery at present used with this machine is a six-cell Daniell's, three cells of which are sufficient to drive it; zincs, 1½ inch by 8 inches. The break-wheels are so arranged that they make and break contact when the metal portions of the contact cores are full in the ports; consequently, in the best position for receiving the induced currents. These currents are carried off by means of helicle copper springs, which are attached to the contact cores at one end, and to binding screws at the other. The magnetism ceases in one set of spools just before it is excited in the other, and the consequent oppositely-flowing induced currents are caused to blend by the similar free poles of the spools being placed opposite; the remaining rectification of the induced currents is brought about by the commutator in the following manner:—Two of the induction ports are connected with each end of the combined induction coils diagonally, that is, the positive terminal is connected with the port nearest the spools on its own side, and with the one farthest from them on the opposite side; in like manner, the negative is connected with the nearest on its own side, and the farthest off on the opposite. From this it will be seen that when the two ends of the contact cores farthest from the spools are full in their ports, they will be in contact with the opposite ends of the induction circuit to what they will be when their ends nearest the spools are full in their ports, and that each oscillation will reverse these contacts; but at each oscillation the currents are reversed; consequently, one contact core will always receive a positive current, and the other a negative current. These machines can be made to give any degree of tension or quantity simply by varying the length and thickness of the wire with which the spools are wound, and may also be worked with one cell of a battery or more, as required; even the present machine, which is for large quantity, with slight alteration can be driven with one cell. The invention can be seen at the Whittington Club, Arundel-street, Strand, on application to J. B. Thompson, Esq., the patentee.

ON THE PATENT LAWS.

DISCUSSION.

(Continued from page 225.)

Mr. WM. HAWES said at present the discussion had gone entirely in one direction. Nearly every gentleman had, to a certain extent and in various degrees, supported the present system of patent laws, or rather the principles on which they were based. He would in the first place reply to the observations in the very able and modest paper of Mr. Webster, because that gentleman, while criticising severely the arguments contained in a paper which he (Mr. Hawes) read before the last Social Science Congress at Glasgow, he had done it in so agreeable a manner as to make it a pleasure rather to hear himself criticised than to raise a word of complaint as to the manner in which the freedom of criticism was exercised. They must allow him to say that he thought the paper they had just heard grappled with only a small portion of the subject. Mr. Webster treated the patent law as an inventors' law only. He did not touch the patent law as a public law, affecting public and national interests, but he had laid down the propositions that invention was entitled to protection, and that there was a property in inventions; and having stated these two propositions, he went on to defend them, and to show how that property should be protected and how that principle was to be supported. He (Mr. Hawes) would not gainsay that there was a property in invention, but he would say the patent law by which they attempted to maintain that property was injurious to the nation, was not on the whole beneficial to the inventor, and led a larger number into difficulty and ruin than to fortune and success. Mr. Webster had drawn a very interesting distinction between invention and discovery. It was a distinction which might be drawn in a paper of this kind, read before an intelligent body of men, but it did not apply to the great practice of the world. It was impossible by law to define the difference between invention and discovery, and so long as there was that undefinable difference there would always be great difficulty in practically separating them, and in maintaining that some of the greatest discoveries were not inventions; for what discovery did more good, or had saved more lives, than the discovery of chloroform? and yet the men who discovered that agent, by the rule now laid down, had no right to reward or to have their services acknowledged by the nation. He said it was taking a wrong view to endeavour to establish such a distinction. They could not maintain it in practice, and it would confuse instead of elucidate the question. It was a distinction without a practical difference, which he could not admit as applicable in this case. Reference had also been made to the protection afforded by copyright. He was told that the copyright protected one man only and one work only, whereas the patent right went beyond that, for it not only protected the inventor, but protected his machinery and property, and prohibited others from using that machinery and property without his leave and license. But a book, a picture, or any artistic work was only so far protected by copyright as to secure the individual producing it against the exact reproduction of that which he had produced, and the world was allowed to benefit by that work, and to use it as they pleased, improving upon it, using the same materials or arguments, so long as they did not copy or sell that which was an exact copy of another man's mind. There was protection to intellect and property in it; and when they went beyond that, and prevented men applying any portion of a previous invention without the leave and license of the patentee, they did an injury to society, they obstructed progress, they increased the cost of production to the public, and delayed rather than increased the progress of invention. These distinctions were worth bringing forward by the author; they were interesting, and deserved consideration; but they did not meet or grapple with the real question—What was a patent? what was it granted for? for whose benefit was it granted? and did it do good or harm materially? A patent right was a monopoly; it was a remnant of the laws of olden times. It gave a man a right for years, to the exclusion of all others. It prevented other men from using, by directly improving upon it, that which another had invented. It was originally intended, no doubt, for the benefit of the individual, and not for the benefit of the country, for the registration of specifications was originally intended to prevent the loss of inventions, or the means whereby new things were produced. He disputed the principle on which patents were founded. He repeated that it was for the benefit of the individual that certain restrictions were enforced, and not for that of the country. For instance, the registration of the specification was considered to be for the benefit of the patentee as well as of the public, and as the best means of perpetuating the discovery. The principle on which that registration was founded was not applicable to the present time. Every patent law was a prohibition to the world. When a specification was taken out, it was not, he apprehended, with a view of concealing the object, but rather of announcing the discovery to the world. It was a publication of what had been done, but which the inventor's own countrymen could not use without his license, though the rest of the world might use it without any charge whatever. His friend next him (Mr. Graham) reminded him that the patent might be taken out abroad. They might take it out in many countries, but what check was there against the use of it compared with that in our own? Some few patents were secured abroad, but with the great mass very little good was done to those who invested their money in foreign patents. The evil of the publication of specifications in the present

time was that it was the means of assisting our rivals abroad gratuitously to that for which we obliged our own countrymen to pay a royalty, so that while we sent them our inventions broadcast over the world to be used in other countries by our rivals, without payment, we taxed our own industry. Was that just to ourselves, and was it the means by which the patent law upheld the great manufactures of this country, and rewarded inventors? He said not only was the patent law injurious, but it was also detrimental to the progress of our own manufacturers, because it held out a premium to the manufacturers abroad to reproduce our best productions. Look at it in another point of view. What was the number of patents taken out annually in this country? There were about 3,000 new inventions patented per annum; this had gone on year by year since 1852, so that between 25,000 and 30,00 patents had been granted during the last ten years. Where, then, was the progress of discovery by which they could mark the beneficial effect of these 25,000 or 30,000 patents? What was the cost of them? A million of money had been paid in official fees. How much more would have been paid in law to protect them, if each had had to be defended in 150 Chancery suits, might be more easily imagined than correctly stated. There could be no doubt litigation was a matter which added considerably to the charges for those patents. Then how did they test the results obtained from these 30,000 patents during the last ten years? If they looked to the Jurors' Reports of the Exhibition of 1862—not the opinion of one or two of them merely, but of nearly all—they would see the opinion expressed that the results of new invention in the previous ten years were not such as might have been anticipated, notwithstanding the large number of new patents taken out. That was the result of a million of money spent on patents; that was the result of investments, many times greater, in the experiments, labour, and machinery required to justify taking out a patent, and in law expenses to defend them. Then, to go a little further, let them look at the amount of property in these patents. He had said on an average there were 3,000 patents taken out annually. There were 3,200 patents taken out in 1862. Of these 3,2000, 1,200 died a natural death before having arrived at the great seal, £5 in fees, besides other expenses being paid on each. That was the first instalment under this law—1,200 out of the 3,200 were not considered worth the £20 to secure the first step. The expenditure on these 1,200 was all lost. That left them 2,000 yet to be dealt with. Of that number only about 550 paid the £25 necessary to get an extension for three years; therefore there were about 1,500 of the 2,000, every one of which was impeding progress, and was a fetter upon some other genuine inventor; 1,500 sank and died rather than pay the £25 to continue the protection for three years. Then what became of the other 550? £50 must be paid at the end of the third year to continue the protection for seven years, and only 100 got to that stage, so that out of the whole 3,200 patents the full fees were only paid upon 100 for the extension of the exclusive right for another seven years. If they wanted stronger facts than those to prove the absurdity of the Patent Law, they had only to look at the records of the Patent Office to satisfy themselves that whatever of good there might be in the principle of patents, it was not to be found in the patent law as it existed in this country; but having these facts, what could be said in support of protection to property in patents, if only 100 out of 3,200 were worth £100 at the end of two years. We might be told that the argument he had used, that they were beneficial to foreigners while useless to ourselves, was of little value, because inventors might take out patents for foreign countries. That appeared at first sight an answer to the argument, and he was asked by Mr. Webster to show them an instance in which an invention of this country had been used to our disadvantage abroad. How could his friend expect him to show an instance of that kind? All he could say was if the patents were so useless to foreigners that they rarely or never used them, when they had no fees or law expenses to pay, when they could get them without labour, without anxiety, without taxation—if they were useless to them what use could they be to this country? If these patents were of so little value that they might be thrown broadcast among our great manufacturing rivals all over the world, could they believe the maintenance of the law under which they existed, and which involved taxation of the public to a great extent, and which pretended to foster invention and reward the inventor—could they believe it was of much service to this country? Let them look at the reward it gave to inventors—how was it tested, where to be found? Every speaker had referred to the losses which inventors encountered. It was notorious that the great bulk of inventions had not rewarded the men who had produced them. Undoubtedly men had been rewarded who improved upon the inventions of others. The men who invented the beautiful dyes from a waste and almost noxious product—the two distinguished men who discovered the existence of those dyes, never received a penny for their services; while a comparatively obscure chemist—a man having no right whatever to claim reward for the invention—took out a patent founded upon the skill and research of Faraday and Hofmann, and that man and others were making large fortunes from the results of the labours of those two great philosophers. He said, as against the country, that right ought not to have been granted. Then Smith, the inventor of the screw propeller, was not adequately rewarded; others had benefited largely by additions made to that great discovery, but the man who devoted his life to the subject got nothing for his patent. There were plenty of patents, extending over a long range of inventions, which had not been profitable to the patentees, which had, on the contrary, ruined the inventors, whilst the rewards had been reaped by a class of men who did not deserve the name of inventors, who would succeed whether they had patent laws or not; but who, out of a bad protective system, had derived large fortunes, and therefore were the supporters of these laws. The same language might be used with regard to the great originator of the Penny Postage; and the corn laws were at one time regarded as necessary for the protection of the interests of the British farmer; but he would say that the abrogation of the patent laws, instead of defeating invention, would be a great stimulus to it, and they would never, under the present law, do so much for this country or for individuals as they would by allowing every man to win the laurels earned by his own brain, and allowing the country to reward him for his labours. They did not find that the philosophers, the physicians, the surgeons, or the great artists and authors of this country were deterred in their career of usefulness or of invention by want of patents; yet they were not wanting in discovery, which they applied to the benefit of mankind at large. No country possessed greater philosophers, greater physicians, greater surgeons, or greater artists than this, from Sir Humphrey Davy down to Faraday and Hofmann, and yet all had worked on without the stimulus of the patent law. This was his view of the patent law; but while he was entirely opposed to the present law, he did not say there should not be some system by which real inventions such as those of Rowland Hill, Smith, Hofmann, and James Watt, should meet with some reward. He believed there were means to be discovered by which great inventors and great inventions—he did not mean mere additions and changes bit by bit, which he did not call inventions—might meet with a suitable reward. Means might be found by which great inventors—men whose genius led them *con amore* to pursue researches for the benefit of mankind—might be honoured as well as rewarded, and to that extent he desired to reward invention and the individual talent which had led to invention. He would in a few words just call attention to the extraordinary arguments that were used in support of the views that were brought forward by various speakers. They were told that the best mode of remedying these abuses was to have a committee of experts, to whom all inventions were to be submitted, by whom it should be determined whether a patent should be granted or not. Would a man who knew anything about inventions submit to have his plans tested by those who were in arrear of him? because the essence of invention—the position a man placed himself in as an inventor—implied that he had more knowledge than his neighbours, and was in advance of the experts to whom it was proposed to submit his invention; and, taking mankind as it was, a man who was an inventor, and was in possession of a new principle, would be unwilling to submit it first to such a body of men, and then be found to give up his idea because those men said it was not new, or it was not likely to be a profitable patent. An inventor must be a man in advance of his age, and yet he was to be asked to submit his plans to those who were behind him, and who perhaps could not thoroughly estimate the value of the new principle brought before them. Let them imagine Mr. Winsor, the inventor of gas-lighting, submitting his plans to those who would have been the experts upon public lighting in that day—the great oil-merchants—and asking them to decide whether gas was capable of giving as much light as the old oil-lamps. Did they think they would ever have had gas? In 1814 the idea was ridiculed of passing gas along the streets in pipes like water. Then, again, the idea of submitting to such a body the question whether a wheel should have twenty instead of thirty cogs, or a particular fix of gearing—it was nonsense to call that invention; or whether a lever should be ten inches long instead of sixteen? or whether a sewing-machine should have one shape of needle instead of another, or this or that kind of stitch?—to call those inventions was an absurdity and an abuse of terms. Patent right, if he understood it rightly, was to protect that which was entirely new and useful—not to protect those things which were the necessary consequence of the application of a man's ingenuity with hundreds working at the same thing day by day. There was one remark of his friend (Mr. Graham) he must notice, that was with respect to the reluctance of great manufacturers to encourage new inventions in their own branch of trade, and he illustrated his view by one case in which the inventor brought his own designs into operation, and made a large fortune thereby. His friend also said that very rich men never troubled themselves about new inventions; but he would say if there was one man in the metropolis more ready than another to advance capital in the promotion of a really good invention, that man was his friend Mr. Graham, and he thought that was the best answer to his friend's argument. The inventor must have a capitalist with him, because it was said not to be in the nature of things for an inventor to be rich. Many great inventors were comparatively poor men. Roberts, the inventor of the self-acting mule was a poor man; and probably a few days hence this room would be appropriated to a meeting for the purpose of providing a subscription for his daughter, who was left in bad circumstances. His principle was if there were inventors—if they acknowledged them as such, they ought to find some means by which their talents should be acknowledged by a grateful country; but he did not apply that observation to a host of men who had no right to the protection which they sought, and he denounced the present system as untenable upon any sound principle.

Mr. Newton Wilson expressed a hope that as there were many gentlemen present who were desirous of speaking on this subject, the Council would consent to the discussion being resumed on a future evening, and he therefore moved that the discussion be adjourned.

Mr. SPENCER thought there was a great mistake in the nature of this discussion. They were going into details, and no one looked at the great principle at stake. Sir William Armstrong, the *Times* newspaper, and all who advocated the abolition of the patent laws, went into matters of detail, which, when investigated, came to this, that the patent laws were not carried out as they ought to be; that patents which ought to cost only £5 cost £100; and that the large sums annually expended on that account were owing to so-called inventors being allowed to protect their inventions. He thought that was wholly beside the question. He thought, with all deference to Mr. Hawes, that he entirely misapprehended the question. He did not think they could judge from facts, for facts had been wrongly applied, because wrongly brought about. If they had an institution so badly conducted as to check invention rather than encourage it, and from thence it was argued that the patent law was wrong, he thought that was no argument whatever. He (Mr. Spencer) considered there was a right in the individual as well as in the public? There was an undoubted property in invention. Mr. Hawes said he appreciated the inventor, but could not appreciate the man who went on step after step in the improvement of an invention. He would refer that gentleman to his own case of James Watt, and he asked where would have been the splendid results now realised in our great commercial steam marine if there had been no improvements made upon Watt's discovery and invention? Were they to keep the ashes of the dead for hundreds of years, and say that no benefit should accrue to the man who brought the results of improvements before the public? What was the test of the value of an invention? It was the benefit the public got from it. If they could now get the same amount of horse-power from an engine with 3 lbs. of coal that Watt got with 8 lbs., he thought that was a *bona fide* advance, the merit of which was due to later invention. But that was attained step by step, and yet this was what Mr. Hawes had depreciated. He thought in the matter of property in an invention there could be no misunderstanding. A man having a small cottage was as much protected in his rights as the man with large estates. He said if a copyright was allowed, and if a man was allowed to print his thoughts, and give them to the public as his own, the man who invented ought to be allowed to do the same: and of the degree of merit in invention he did not think they were fair judges. If such a board as Mr. Webster had suggested had existed, nineteen-twentieths of the present patents would not have come into existence. He was not arguing so much upon the present state of the patent laws as the state they might be in if the suggestions of Mr. Webster and others were carried out. That was the question now before them. It was the question whether individual right was to be respected—whether a man had a right to hold his own invention as a property. If not, what was the use of discussing the matter? He held that on every ground there was a right. The man who invented had a property-right in the thoughts he had worked out into a practical form, and unless that right were accorded, invention would go down. They were arguing as if capitalists were the most liberal and appreciative class of men—as if their language was, "Come to me with your invention, and I will pay you handsomely for it;" whereas he believed the rule was (though there were noble exceptions), "I will get as much as I can for myself, and will pay as little as possible for it." So far, therefore, from holding the views of Mr. Hawes, that invention would go on better, he believed it would not go on at all. He spoke as a patentee himself—one of the step-by-step men. He had spent his life in doing certain things, and he believed he had done good in a small way; and if inventors did not look for money reward, they looked for large results in another way. But it was the case with some men that the genius of invention, was within them, and it must come out; and when it came out they were justified in keeping it to themselves up to a certain point. If they admitted that a man's thoughts were beneficial to the public, he had a right to the same protection, that he might receive the value of them in return, as he would receive in the case of his cottage or his houses and lands.

(*To be continued.*)

ROYAL SOCIETY SOIREE.

MAJOR-GENERAL SABINE's last reception this season was held on Saturday last at Burlington House, and, as usual, passed off with the most complete success, both Science and Art—for once associated to their mutual advantage, in spite of "Y.'s" pungent and too true letter to the *Times*—being called upon to do duty for the general entertainment.

Most noteworthy among the philosophical instruments dealing with electricity, both on account of its novelty and the beauty and variety of the phenomena produced by it, must be mentioned an apparatus for showing the rotation of an induction spark *in vacuo* when connected with an electro-magnet exhibited by Mr. Edward Atkinson, who has just received it from the celebrated Ruhmkorff. The apparatus consists of a powerful electro-magnet, mounted horizontally on a stand, to which is attached a bell-shaped glass receiver, closed at the end with a glass plate. A thick bar of iron, forming the pole of the electro-magnet, projects into the receiver, which communicates with a stop-cock screwed into the other extremity of the iron bar by means of a hole drilled through it. A vacuum can thus be obtained in the receiver by means of an air-pump. A ring of copper wire surrounds the pole of the electro-magnet at a distance of about two inches from it, and can be connected with one of the rheophores of an induction coil, the other end of the coil being in contact with the iron bar. A commutator is attached to the helix of the electro-magnet, for the purpose of making and breaking contact with the battery or reversing the current. When the receiver is exhausted, a spark passes between the pole of the magnet and the copper ring, and, if the iron bar from the negative terminal of the coil, it becomes beautifully illuminated by a violet light, which is seen on the copper wire when the induced current is reversed. If the battery be now connected with the electro-magnet, the spark is seen to rotate round the iron pole; and, on reversing the current in the magnet, it rotates in the contrary direction. The velocity of the rotation depends on the degree of pressure in the receiver, and the power of the electro-magnet. When the vacuum is tolerably perfect, a moderate battery power is sufficient to produce a rapid rotation; but, on admitting a little air into the receiver, the velocity is less, and it is necessary to increase the number of battery-cells in order to obtain the same rate of speed. The experiment is one of the most interesting in electrical science, and when a little ether vapour is present in the receiver, the effects produced are extremely striking.

Mr. Ladd exhibited a similar instrument (in which, however, the magnet did not form one of the electrodes), and a series of Geissler's tubes of unrivalled beauty.

But electricity was at work in other ways. Messrs. Silver & Co. exhibited one of the semaphores of the Patent Electric Signal Company, and there were relays, improved voltaic batteries, telegraphic insulators, and specimens of cables to which we cannot allude more closely. We must not forget to mention also the newly-imported gum, named Balata, a portion of which, in its manufactured state, was exhibited.

An electric safety distance-signal for railways, invented by M. Hipp, of Neufchatel, and in operation on many, if, indeed, not all of the Swiss railways, and, of course, on the London, Chatham, and Dover Railway, was examined with much interest. The signal consists of a column surmounted by a disc, which is turned edgeways to the line for safety, or flatways for danger. The disc is turned by means of a descending weight. The mechanism on which the weight acts is stopped by an electro-magnetic detent, connected by conducting-wires with a battery at the station. When the detent is set free, the signal is turned to its required position by the weight coming into play, and on reaching it signals back that it has done so. Ingenious contrivances guard against any impediment to the working or action of atmospheric electricity. Professor J. Clerk Maxwell exhibited an experiment to determine whether the earth's motion affects the refraction of light, a model of a body moving similarly to a particle of a fluid medium which rotates the plane of polarized light, and an opthalmoscope on an entirely new model.

The opthalmoscope exhibited by Professor Maxwell is founded on the principle of Helmholt's opthalmoscope, in which light is reflected into the patient's eye by a set of plates of transparent glass, while the observer looks into the eye from behind the glass plates. The chief difficulties in observing the structure of the interior of the living eye arise from the smallness of the pupil, which compels us to observe by looking in the same direction in which the light entered, and the refraction of light within the eye, which renders the image indistinct, unless we have the means of altering the convergence of the rays. These difficulties are overcome by a combination of two lenses of two inches focal length, forming a kind of inverting telescope which does not magnify. The eye of the patient is placed at an eye-hole two inches from the lens, and the observer places his eye at another eye-hole two inches beyond the other lens. Whatever may be the distance between the lenses, the two eye-holes are *conjugate foci*—that is, any ray passing through the one will pass through the other; so that, by placing the eyes as described, each person receives through his pupil any ray which emerges from the pupil of the other person. But, as the eye is not self-luminous, the light is thrown into the patient's eye by means of one or more thin plates of transparent glass, interposed between his eye and the nearest lens, and inclined at an angle of 45° to the axis of the instrument. The patient then sees distinctly the reflection of the lamp, candle, or aperture in the shutter of the window placed on one side of the instrument, while the observer, by looking through the other eye-hole, receives the light which emerges from the eye and passes through the transparent plates. By adjusting the distance between the lenses, the image of the lamp on the fundus of the eye is distinctly seen; and, if the patient looks to the side of the lamp next his nose, the entrance of the optic nerve, with its blood-vessels, can be seen, and the focus may then be more carefully adjusted so as to see the more minute structure of the parts. The light reflected from the cornea is seen as a diffuse disc of light, and does not greatly disturb the observation; but it is easy, by means of a wire passing through the tube near the observer's eye-hole, to cover the image of this spot without interfering with vision. The fundus of the eye, with the images of luminous objects on it, is then distinctly seen free from extraneous light. As the instrument is symmetrical with respect to the observer and patient himself, the size of the images being equal in the two eyes.

A new aneroid barometer, invented by Mr. Browning, without springs or chain, in which the indication is multiplied by the reflection of a ray of light, must also be mentioned. In appearance it somewhat resembles a balance such as chemists employ for quantitative analysis, being in a glass case on levelling screws. The principal lever which transmits the motion

from the vacuum chamber, is formed of a hollow square aluminium tube. The whole of the pivots work in jewels, and the bearings are of hardened steel working on aluminium bronze. The indications are read off from a pointer, showing a range of about three inches for one inch of the mercurial barometer. This ray of light can also be used to make the barometer self-registering, by means of photography.

Foremost among the spectroscopes was Mr. Gassiot's Kew instrument, which has been recently furnished with a train of eleven bisulphide of carbon prisms by Mr. Browning, who has introduced many improvements worthy of the highest praise. In the first place, Mr. Browning, taking advantage of the difference between the refractive and dispersive properties of crown glass and bisulphide of carbon, has substituted a prism of crown glass, having a refracting angle of 6° for one of the outer plates of each prism; the base of this crown glass prism being brought to correspond with the apex of the fluid prism. By this means the angle of minimum deviation of the prisms is so much, decreased that eleven of them thus constructed can be used in a circle instead of eight. An increase of dispersive power, due to refracting angles of 150° of the bisulphide of carbon, is thus gained, minus only the small amount of dispersion counteracted, owing to the dispersive power of the crown glass prisms being employed in the contrary direction. Again:—In the fluid prisms of the ordinary construction the sides are cemented on with a mixture of glue and honey. This cement, on hardening, warps the sides and confusion of the spectral lines is the result. To obviate this Mr. Browning attaches an additional pair of parallel sides to the prisms, a thin film of castor-oil being interposed between the surfaces. The outer plates are then secured by means of sealing-wax, or some cement at the corners. In the Kew instrument Mr. Browning has dispensed with this attachment at the corners, which is likely to prove prejudicial, and has secured the second sides in their proper position by extremely light metal frames which clasp the plates only on their edges. Thus arranged, they exert no pressure on the surfaces of the plates; they are quite out of the field of view, and can be handled without any fear of derangement. Each prism, in addition to this metal frame, has a separate stand, furnished with adjusting screws for obtaining proved horizontality of the prisms, and securing them at the angle of minimum deviation for any particular ray. By this arrangement the prisms can be removed and replaced without being touched—a matter of some importance, as all fluid prisms show different results with every change of temperature.

Applied science was well represented. We may briefly chronicle Gisborne's patent mechanical signal apparatus for naval use, as fitted on board Her Majesty's iron frigate Achilles, and his apparatus for striking large bells, whereby full tones are produced without danger of cracking the metal—exhibited by Messrs. Silver & Co. and F. N. Gisborne; a model of floating dock constructed for the Spanish Government at Cartagena; models of double-screw gun-boats, contributed by Messrs. Rennie; model of jointed cast-iron bridge, lighter than the usual form of wrought-iron girder, with diagram showing the strains, by Mr. Fleeming Jenkin; and specimens of cold-drawn steel tubes and gun-barrels, exhibited by Messrs. Harding & Hawksworth. These tubes were produced by cold drawing from a hollow ingot of metal in the same manner as wire is drawn, except as regards the difference in the tools required to produce the tubular form. As the power necessary is of course much greater than in drawing brass or copper, hydraulic pressure is employed. The hollow ingot of metal, fixed to a flange attached to the ram of the hydraulic press, is dragged through a collar or die placed on another flange cast on the cylinder. As the ram is driven forwards by the water it carries the tube or tubes with it. Tubes so drawn acquire a considerable amount of additional strength, for it is calculated that metal drawn into wire—say a piano wire—gains 300 per cent. of tensile strength, which is rather increased in this process, from the fact of the metal being acted upon both internally and externally, and thus a tube can be formed which is stronger even than the solid mass. Tubes or solid bars of metal of all sections appear to be produced with the greatest truth and regularity, and are of infinite application. Tubes can be made as small as a needle, or as large as an Armstrong gun, offering new facilities to engineers and artillerists. They seem to be admirably fitted for boiler-tubes, gun-barrels, piston-rods, heavy ordnance, and for any articles of similar form requiring precision, strength, and lightness. If steel tubes can be obtained as thin and as strong as appears to be possible by this mode of manufacture, a new field is opened to engineers, and new combinations may be formed, the limits of which it would be difficult to fix, especially in its relation to the steam-engine. Among the specimens exhibited were some steel tubes, which illustrated, possibly, the way in which the molecules of metal arrange themselves under great pressure, as on the surface of the tube a herring-bone damask was visible, the ribs of which, crossing along the axial line, descended on each side in regular diagonal stripes, about an eighth of an inch apart.

Messrs. Elliott exhibited some of Richard's steam indicators, which are now in extensive use. The peculiarity of them is that the piston has only a throw of seven-eighths of an inch, which is multiplied four times by a parallel motion. By this means diagrams can be taken with the greatest accuracy from engines with 250 revolutions per minute.

Here we draw to a close, although we have not yet exhausted the list of scientific objects exhibited. But Art was equally well cared for, the Queen being again among the exhibitors, and the new method of photo-sculpture being explained by its inventor, M. Willème, and by M. Claudet.—*Reader.*

CORRESPONDENCE.

BONELLI'S TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your extract from London papers, headed "Challenge to the Bonelli Company," of the 30th ult., I perceive in one of the paragraphs a statement "That the system (Bonelli's) had been at work between Liverpool and Manchester since September last, without a single interruption from weather, or electrical causes." This is inaccurate, as the Bonelli line was entirely broken down from the middle of December of last year, to the latter end of February of the present one, during which time not a single message was sent or received between Manchester or Liverpool.

Yours truly, ———.

Manchester, May 11th, 1864.

A QUERY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have constructed a bell; it works very rapid, but exceedingly weak; my battery consists on short circuit for experiment of six cells, with gutta-percha jars, and porous pots, and of copper 2½-in. × 7½-in., excited by very dilute acid (sulph.), sulphate of copper, and area of zinc plate, 2½-in. × 2½-in.

I want to connect seven rooms to one bell and indicators, and carry another to the workshop (75 yards length of conductor), and work them from one battery. Will twelve cells be enough?

If you, or any of your readers, will kindly favour me with the size wire for the magnet and dial, and length of the soft iron core, with the area of zinc and copper plates for a battery to work the above, I shall esteem it a great favour.—I remain, sir, yours respectfully,

AN AMATEUR.

TELEGRAPHIC NEWS.

SILVER'S INDIA RUBBER WORKS AND TELEGRAPH CABLE COMPANY (LIMITED.)—The Committee of the Stock Exchange have appointed the 18th instant for settling and marking the shares in the above Company.

SUBMARINE TELEGRAPH COMPANY.—The Tonning cable of this company, which had been injured by its having come in contact with a wreck, has been repaired under the superintendence of J. H. France, Esq., the acting engineer of the company.

LONDON DISTRICT TELEGRAPH COMPANY.—Telegrams can now be sent from any of the stations of the Metropolitan Railway to all parts of the United Kingdom and Continent at through rates. An arrangement has also just come into operation whereby messages for any of the South-Eastern stations can be sent from any of the London District Telegraph Company's offices at the same charges as from their own stations.

THE TELEGRAPH IN AMERICA.—The United States Telegraph Company have constructed during the past year nearly 2,000 miles of telegraph, and during the present season they intend to erect more than 4,000 miles more. Their lines are now in operation from New York to Albany, Buffalo, Cleveland, Chicago, and Milwaukee; and by way of Philadelphia to Pittsburg and Cleveland. Within a few weeks their lines will reach to Cincinnati, and during the summer will be extended to Louisville, Kentucky, and St. Louis.

INTERESTING TELEGRAPHIC FEAT.—Some telegrams sent on Monday and Tuesday from Heligoland by this line, narrating the progress of the naval action between the Austro-Prussian and Danish fleets, were received, owing to the difference of longitude, in the following order:—Sent from Heligoland at 12.23, received at 12.19; sent at 2.10, received at 1.49; sent at 4.15, received at 3.54; sent at 12.10, received at 11.50; sent at 12.23, received at 12.19.

ATLANTIC TELEGRAPH COMPANY.—We have been informed that the above company's cable is being now manufactured at the rate of ten miles per day. There is, however—as has been the case with all previous cables, with the exception of the Persian Gulf cable—the profoundest secrecy maintained with respect to the nature and extent of the tests to which it is subjected. A few weeks since a number of gentlemen were invited to witness the manufacture of the cable, but we looked in vain for the name of any one who could have formed any opinion on the subject as a practical man.

A SUBMARINE VESSEL.—Several of the Continental journals contain the following paragraph:—"A submarine vessel of colossal dimensions is now being built at Cronstadt, in the construction of which 2,000 tons of iron and steel will be used. She is to be moved by two large engines, worked by compressed air, is to be armed with a powerful spur, and will carry every accessory for fixing to the hulls of vessels large cylinders of powder to be fired by electricity. Large glass-covered openings will enable the crew to direct the course of the vessel; they will also be able to regulate the depth at which she is to swim, but in general the vessel will be near the surface. The Emperor recently signed a decree appropriating 673,000f. for the construction of the sea monster."

The United Kingdom Telegraph Company.—The above Company have now extended their wires to the important towns of Cardiff, Newport, and Gloucester, at which stations have been opened for public business; the charge being 1s. for each message of twenty words.

Telegraphy in Vancouver's Island.—The *Weekly British Colonist*, of the 15th March last, states that on the previous Saturday his Excellency the Governor gave his assent to the telegraph bill lately passed through both houses, and it is now the law of the land. It is to be hoped that the construction of the telegraph line will be commenced and carried on with a like commendable despatch, and that we may before the close of the present year be enabled to exchange greetings with our eastern neighbours, and perhaps even with the old folks at home.

Cape Clear Telegraph Station.—The British and Irish Magnetic Telegraph Company have stationed a steamer at Cape Clear to intercept the American Mail steamers, and thus expedite the transmission of messages from that point. In order that messages may be placed in the company's canister for Cape Clear, merchants and others receiving messages from America should instruct their agents to have the messages marked "viâ Cape Clear." Arrangements have also been made for reporting vessels passing Cape Clear for owners and consignees, and for placing orders on board.

Contract Messages.—The London District Telegraph Company, in order to facilitate the more general use of the telegraph, announce that it is prepared to enter into subscription contracts for any number of messages, at greatly reduced rates. The reduced scale under this arrangement will be 20s. per 100 messages, not exceeding fifteen words each (exclusive of name and address of sender and receiver), and for extra words at the same rate, exclusive of any special charge for porterage. The messages must be addressed either to or from the subscriber. It is required that each subscriber should take 20s. worth of free message franks to commence with; an account will then be opened on the above terms for future messages, and which will be forwarded from any of the Company's Offices without prepayment.

The Great Eastern.—A morning contemporary states:—"We are informed that the steamer Great Eastern has been sold to the French for a sum approaching a quarter of a million sterling. This, however, will not interfere with her present engagements, which include the submersion of the Atlantic cable. The Great Eastern was purchased at Liverpool, at auction, about three months ago, for a sum of £25,000, but, as the mortgage debentures had been previously bought up, the total cost was, probably, £70,000 or £80,000. There is, however, a very handsome profit on the present transaction. At the time of the excitement in connection with the Trent affair this vessel took out a very large number of English troops to Canada at a single trip; and in view of her great capabilities for this and similar services, her present transfer altogether from English hands is regarded with regret in some quarters. It is rumoured that the purchase has been made on account of the French government."

The subjoined is a copy of a letter posted at Lloyd's to-day. The writer, Captain Rowett, has lately obtained from France a concession, giving him exclusive right, for 50 years, to lay telegraph cables from that country to America:—"32, Charing-cross, May 9.—Dear Sir,—The time has arrived when the committee you have the honour to represent can do their part in adding another insurable difficulty to the vast field of operations already known to underwriters. By the concession lately granted you will have seen that the great cause of ocean telegraphy has been taken under the patronage of the Imperial Government of France, and there can be no doubt more than a hundred millions sterling of insurable risks will be developed. To this end I am prepared to prove to underwriters—1. That there is no moving water at the bottom of the ocean. 2. There is no pressure at the greatest depths to injure any cable. 3. That the cable will rest at the bottom without risk to its electrical integrity. 4. That a hempen cable, with the properly-insulated conductor in its centre, can be laid safely, and be under perfect control in stormy weather as well as in fine. 5. That when a good hemp cable is not loaded with iron it can be recovered even from the greatest depths as certainly as the hempen sounding line has so often brought up with it specimens of the bottom. 6. That hemp absorbs and holds a solution which preserves it from decay, which iron cannot do, but is subject to destructive corrosion by the salt, which on the other hand, is well known to preserve hemp. These facts alone render ocean telegraph cables simple and insurable risks at moderate rates of premium, when coupled with the proper electrical tests after it has been shipped. But I am prepared also to show that currents of the ocean do not exist but in a superficial degree; and are in no way dangerous to the laying of ocean cables. Permit me to remind you that it was officially reported the current had carried away the Atlantic cable, in fact, that the necessary restraint of 35 cwt. on the breaks broke it, and thus nearly 400 miles of cable was lost. What can be more dangerous than to act under erroneous impressions? The fact is, in extreme depths the weight of the iron cable was so great that it could not be controlled, and it broke from this cause. Current had nothing whatever to do with it. By this and similar errors in the present practice of ocean telegraphy the country has been for years deprived of a vast industry for the labourer, besides the commercial, social, and imperial advantages, which are incalculable. I shall be glad to explain this subject to any of your underwriters, and I have the honour to remain, your obedient servant, W. Rowett.—Capt. G. A. Halsted, R.N., Lloyd's, Royal Exchange.

The Atlantic Telegraph.—The cable destined to connect America with Europe has now been fairly commenced, and by this time next year we expect to announce the preparation for, if not the actual departure of the Great Eastern steamship with the cable on board. It is understood that neither Her Majesty's Government, nor that of the United States, will again grant the use of any of their vessels, as on the occasion of the former attempt; the Company, therefore, will have to rely entirely upon their own resources. On the former occasion the cable was carried in two ships, and the difficulty of laying it was, of course, considerably increased by the fact of each ship having to lay its own portion practically independent of the other. The Great Eastern will admit of the whole length of the cable being stowed away on board, and in such a manner as to be payed out with much greater facility and less risk of failure than from the hold of the smaller frigates formerly engaged. The "big ship" will also, there is every reason to believe, pitch much less than a smaller vessel, and consequently cause less strain upon the cable in the process of paying out, with a corresponding diminution in the risk of damage. Not only are the prospects of successful submergence greater than before, but there is every reason to believe that the cable, when laid, will satisfy all the electrical conditions necessary for its success.

The United Kingdom Electric Telegraph Company.—On Monday, this company opened their offices in Edinburgh and Leith, so that "shilling telegrams" may now be dispatched from Edinburgh to London, Liverpool, Manchester, Birmingham, and all the leading towns to which this company has opened communications. This is the first Scottish line of this company, and it runs through Dalkeith, Jedburgh, &c., to Newcastle, where it joins with the company's other trunk lines. The Shilling Telegraph Company use the printing instrument and relay system of Messrs. Siemens & Halske, by which all large towns are put in direct communication with each other by a kind of automatic manipulator, so that the company have not only brought us a boon of a "shilling telegram" system, but also a kind of guarantee for efficient and quick working. This company has also obtained the exclusive right to use Professor Hughes' type-printing instrument, which prints the message in actual Roman type; and the company are making great preparations for extending the use of this instrument. By means of this instrument a single wave of electricity gives a complete letter, and at such an excessive speed that the fastest writer cannot keep up to it. The company's main trunk lines already open are from London to Liverpool, through Oxford, Leamington, Birmingham, Wolverhampton, Manchester, &c.; also from London, through Uxbridge, Nottingham, Sheffield, Wakefield, Leeds, Sunderland, Hartlepool, Newcastle, and Edinburgh, to Glasgow. Another trunk line runs through the west of England, connecting nearly all the principal sea-ports. The company's offices are situated at No. 1, Hanover-street, Edinburgh, and in the Exchange-buildings, Constitution-street, Leith.

The Indo-European Telegraph.—It will be satisfactory to learn that the Persian Gulf cable has been landed at Fao, and that the difficult operation of carrying it over an almost impassable sea of mud to Busra, and uniting it with the land line at that place, has been successfully accomplished. The most perfect telegraphic communication now exists between Busra and Kurrachee, and Colonel Patrick Stewart will proceed to-day (the 12th inst.) in one of the government river steamers to Baghdad, conveying congratulatory messages from the Indian Government to the Secretary of State, on the successful submersion of the Persian Gulf cable. These messages will be transmitted from Baghdad by the Turkish and Mediterranean telegraphs to Europe in a few hours. Colonel Kemball, the political agent at Baghdad, is engaged, at the instance of the Turkish authorities, in negociating with the Arab tribes along the right bank of the Euphrates for the safe passage of the telegraph wire between Baghdad and Busra. His knowledge of the Arab character and long experience of the country will, it is anticipated, enable him to remove all difficulty to the extension of the wire along this tract. The telegraph works between the Turkish frontier and Persia are being vigorously prosecuted under the superintendence of Captain Champain, R.E. It is confidently reported that India will be in direct telegraphic communication with Europe, viâ Persia and Turkish Arabia, in the course of a few weeks.—*The Times of India.*

The Wonders of a Watch.—There are very few of the many who carry watches who ever think of the complexity of its delicate mechanism, or of the extraordinary and unceasing labour it performs, and how astonishingly well it bears up and does its duty under what would be considered very shabby treatment in almost any other machinery. There are many who think a watch ought to run and keep good time for years without even a drop of oil, who would not think of running a common piece of machinery a day without oiling, the wheels of which do but a fraction of the service. We were forcibly struck with this thought the other day, upon hearing a person remark that, by way of gratifying his curiosity, he had made a calculation of the revolutions which the wheels in a watch make in a day and a year. The result of this calculation is as suggestive as it is interesting. For example:—the main wheel makes 4 revolutions in 24 hours, or 1,460 in a year; the second or centre wheel, 24 revolutions in 24 hours, or 8,760 in a year; the third wheel, 192 in 24 hours, or 69,080 in a year; the fourth wheel (which carries the second-hand), 1,440 in 24 hours, or 525,600 in a year; the fifth or 'scape wheel, 12,960 in 24 hours, or 4,728,400 revolutions in a year; while the beats or vibrations made in 24 hours are 388,800, or 141,812,000 in a year.

MISCELLANEA.

TORPEDOES.—Is it impertinent to inquire if our government is good enough to direct any one's attention to "torpedoes?" We are serious. The United States sloop-of-war Housatonic has been blowed up and destroyed by one of these contrivances. The fine steam-frigate Minnesota has had a most narrow escape from utter destruction with all on board by similar agency. So it is a real, practical, and very terrible agency in war; and it is set at work by those poor Confederates, who have little to aid their ingenuity in mechanical appliances.—*American Paper.*

TELEGRAPH REGISTER.—In all telegraph registers heretofore constructed, the style or steel pen is so attached to the pen lever as to be immoveable laterally; and in order to write upon the paper in as many lines as practicable, the paper has to be moved laterally and the working surface of the rollers has to be of a length almost equal to twice the width of the paper. As one of the rollers is pressed upon the paper by means of springs bearing on each end of the roller, every time the paper is moved laterally these springs have to be re-adjusted, else the pressure of the roller will be greater on one edge of the paper than on the other, causing it to run untrue in its passage between the rollers. Mr. Robert Henning, of Ottawa, Illinois, U.S., thus describes an improvement on all other forms of telegraph registers:—The main object is to obviate the necessity of moving the paper laterally, and thereby obviate the above difficulty; and to this end it consists in the arrangement of the style or pen in a holder which is moveable in a direction parallel with the length of the rollers, by which means also the machine is enabled to be made much narrower, requiring less pinion wire for its construction, and the clock train is made to run more truly by reason of the axles being shorter. This moveable pen necessitates the provision of several grooves in the roller against which the pen operates, instead of only one groove as in the rollers of the registers heretofore constructed, the said grooves corresponding in number and in distance apart with the lines of writing desired to be made on the paper; and the invention further consists in a certain mode of combining the moveable pen-holder with the pen lever, and adjusting it relatively to the several grooves of the roller, whereby the said pen is enabled to be brought exactly opposite to the said grooves and the lines of writing on the paper are always made at equal distances apart, so that a greater number of lines are enabled to be made upon the paper, and the paper thereby economised.

COPPER.—The whole earth appears to be more or less impregnated with this beautiful and useful metal, and the sea contains a notable quantity of it. Copper is in great abundance in various parts of the British isles, in Hungary, in Siberia, in Cyprus, from which island it derives its name, and whence, no doubt, on account of the geographical position of that island, it was principally procured by the Romans. It is also found in China, in Australia, and in Brazil—in fact, almost everywhere. It appears, however, certain that gold and silver were known to the ancients prior to copper. According to Ezra viii. 27, "Copper was as precious as gold." Paul, in 2 Timothy iv. 14, lays a complaint against one Alexander, a coppersmith. These are the only instances in which mention is made of this metal in the Holy Scriptures. Copper takes a rank among metals from its peculiar colour, which, when pure, is of a rose-like hue. Most metals when they become rusty lose their beauty; not so, however, with copper, for it changes into various shades, from pink to a beautiful crimson, as in copper bronze powder, to blue, to green; hence the artist takes it as a pigment to produce upon his canvas "the fields and the forest." In the metallic state copper possesses so many useful qualities that various metal-workers find it of great service. It bears such "wear and tear" that it was adopted as money at a very early period, and retains its good name to the present time. Copper is one of the best conductors of lightning; hence it will be employed to transmit "the flash" below the restless Atlantic, in forming the submarine telegraph between England and America. This metal is so sonorous that few musical instruments can be made without it. The Handel organ and "Big Ben" of Westminster alike owe their tone to copper. Musicians, electricians, artists, and money-makers are not the only persons whose "occupation would be gone" were it not for copper. Colour-makers and dyers are much indebted to it, as well as a host of others who follow the same trade as "Alexander the coppersmith."—*Piesse's Laboratory of Chemical Wonders.*

THE ELECTRIC WAVE.—Mr. Samuel B. Smith, in a communication to the *Scientific American*, says:—"The electric current runs just as a cylinder of two feet diameter runs when turned by a crank and pushed longitudinally at the same time. We turn from the left to the right. So rotates or turns also the electric current or wave—from the left to the right. This law, as it relates to the electric current, is universal. We see that the cylinder turns at its remote end simultaneously with its turning at the crank end. So, likewise, is the turning or revolving of the electric wave. In regard to the wave, however, if the line of its motion be extended to a great distance, the motion of the wave at its terminus is not *precisely* simultaneous with its motion at the commencement. This is owing to the obstacles it has to overcome in its long passage, owing to the imperfect conducting properties of the intervening media along which it has to pass. While the electric wave is thus rotating, it generates at its central line of motion a current at a right angle with its motion; and this is magnetism. This magnetic force or current does not rotate, but runs in a direct course from one of its poles to the other, in a line the motion of which commences with that of the electric wave. This magnetic force or current is very strikingly exemplified in the helices of the ordinary electro-magnetic machines, where the iron wire that is introduced into them becomes powerfully magnetic, with its north and south pole. Besides this rotary motion, the electric wave has also a lineal motion; that is, it moves directly forward simultaneously with its rotation; this constitutes a spiral motion. There is something sublime in contemplating this wonderful force. In it there is found the epitome of the universe. Its rotary and lineal motions represent the motions of the heavenly bodies on their own axis, as well as their obitual motions; the one confined to its own centre, and the other rushing from it. Electricity in motion begets magnetism; and magnetism in motion begets electricity. The two elements, although so intimately related to each other, are, nevertheless, totally distinct in their powers. Glass offers an insurmountable obstacle to the transmission through it of electricity; while magnetism passes through without the least resistance. The passage of electricity is instantaneous, leaving no traces behind of its presence. Magnetism, on the contrary, on certain metals, such as steel, remains in full force. Electricity gives, but loses while it gives; but, wonderful as it may seem, magnetism gives and loses nothing. With one magnet we may make a thousand, without its losing the least of its magnetic power. It seems to be a God-like power. 'God,' as we read, 'created man in his own image.' Gen. i. 27. Yet God is the same he was before man was created, so the magnet remains the same after making other magnets. It is, doubtlessly, these two great principles that sustain the universe, and impart and regulate all its motions."

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Genuine, fine and good	2/2 to 2/6	per lb.
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Para, first quality	1/10 to 1/11	„
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WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	99 to 102	—
100	Submarine Telegraph, scrip. .	all	48 to 53	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

X. L.—We shall have a list of patents and specifications inserted weekly for the future.

Will our correspondent, "An Amateur," favour us with his address?

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.
Whole page	4	4	0
Half ditto	2	10	0
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Four lines and under (single column)	0	3	0

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

THE TELEGRAPHIC JOURNAL.

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DOMESTIC TELEGRAPHY.

It is said that every Englishman's house is his castle. His home may be called his microcosm. He loves to make it his little world in which he can disport all the fancies of his imaginative mind, and nurture the offspring of his fertile brain to minister to his wants and add to his comfort. How soon he applies to his domestic requirements the inventions and appliances of the outer world. He has subdued fire, steam, hot air, coal, &c. to warm his frame, prepare his food, dry his materials, protect him from cold in winter, and diminish the effects of heat in summer. Gas illumines his pathway and brightens up his hearth. Chemistry surrounds him in everything he eats and drinks. Natural philosophy confines him in secure materials, ventilates his rooms, reduces his labours, softens his toils. Electricity now steps forth—his humble but willing slave.

Its admirable adaptability for domestic purposes has recently been fully explained in these columns; and in again calling the attention of our readers to the new electric bell, we are fully impressed with the conviction that electricity has supplied a new want of the age. What householder has not cursed in his heart the bell-hanger. You have carefully laid down an exquisite Brussels carpet—your new furniture is all elegantly arranged—the walls are exquisitely decorated with the newest devices from that great centre of taste and show, Paris—when a sudden jerk at the pull ruptures the bell wire! The bell-hanger is sent for; up comes the carpet, down goes the furniture, and the anatomically correct impression of an oily human hand ornaments the paper.

You are lying ill in bed—sleep has been a stranger for hours—you are just dozing off, as the shades of evening are casting a gentle gloom over the room, in a quiet generous slumber, when a horrid grating noise startles you out of your senses and drives Morpheus away for several more hours. Paterfamilias seated in his cozy arm-chair wants another bottle of port, and his heavy hand on the awkward pull has strained the stiff wire and raised the dreadful *rumpus*. Electricity avoids all this. You have but to impress a slight touch upon a button—the electric force starts into play—it steals noiselessly along the wire, and produces a violent agitation of the "tintinabulum" which would arouse the seven sleepers, were they within hail.

Considerable hesitation has been shown in the introduction of this power into our houses, owing to the imagined trouble and difficulty in maintaining the battery in order. This is pure supposition. The battery will be found to require infinitely less trouble than the gas, water, or any other convenience in a modern establishment. An examination about once a month, an addition of materials about every three months, a cleansing every six months, and a renewal of materials every year are the worst contingencies, and what is this? We have brought the lightning down from heaven to run upon our errands, to bring intelligence over wilderness and under oceans from the uttermost ends of the earth. We guide the mariner through the dark and tortuous channels by its brilliant scintillations. We protect the lives of the millions of human beings that entrust their bodies in the whirling train by its power. And can we not spare one hour a month to domesticate that wonderful power, to comprehend its beautiful action, and to impress its simple principles into our daily service and hourly wants? Man has subdued more difficult agents than electricity to his domestic purposes, and he will soon add the tamed lightnings to his household gods. He has but to understand it, and he will mould it to his will in many useful and advantageous forms. He will use it not only to attract the attention of his servants, but to communicate his commands from floor to floor. He will have it between his hall and his stable, to bring up his carriages and order out his horses. He will, by its means, protect his property from the depredations of robbers. He will, in fact, make it a protector, a companion, and a slave.

THE CONSTRUCTION OF TELEGRAPHS.

In a recent number we laid before our readers some remarks upon the construction of a line of telegraph. In continuation of the subject, we now propose to take into consideration the battery and instruments—the method of charging the batteries and connecting them with the instruments at the various stations.

We have six wires at our disposal, and shall make use of them as follows:—

2 Double-needle Telegraph.
1 Printing.
3 Train-signals.

The first consideration will be the battery. There are many forms of battery, most of which claim our favourable notice. Our choice, however, lies with that of the Daniell form, or sulphate battery; it is constant in its action, requires but little attention, and is easily transported from place to place. Of these the most approved are, the "Muirhead," "ordinary sulphate," and "Fuller." With regard to the power requisite to work a circuit, much information may be obtained by studying the rules quoted and laid down by Mr. R. S. Culley, in his "Handbook of Practical Telegraphy," recently published. "The greatest effect of a given number of cells is produced when they are so arranged that the battery resistance equals that of the line;" but, as faults and leakage will at any time occur, it is advisable that the resistance of the battery should be considerably less than that of the line. When a fault arises, or wet weather prevails, the resistance of a circuit is diminished, in consequence of the means of escape afforded to the current by the fault, or from the dampness of the insulators or supports upon which the wires rest. On a short circuit, or badly insulated line, a quantity battery—that is, a battery formed of large-sized plates—may be used with advantage. On a long circuit, well insulated, there is, however, little if any advantage in increasing the size of the plates, but much may be gained up to a certain limit by increasing their number. The principal thing to bear in mind is, that there must be sufficient quantity to supply the leakage, and sufficient tension to drive a current to the distant end or terminal station. If not procurable a quantity battery can be made up by placing those of smaller plates side by side. Thus, instead of joining the copper terminal of the one to the zinc of the other, connect them up zinc

to zinc, and copper to copper. By this means, with two batteries we double the quantity. The tension will remain the same, but the resistance will be halved. It must, however, be borne in mind that there is a certain disadvantage in employing such a battery for any length of time, unless the cells are all equal in power and conductibility, which will certainly not remain the case for any lengthy period—the stronger will send a current back through the weaker. A deposit of copper forms on the zinc, completely destroying the electro-motive force. Consequently, it is much better to use batteries with plates of double the size—say of 32 square inches—rather than two plates of 16 square inches placed side by side.

We will suppose our wires to extend over 80 miles of line. The double-needle circuit is to accommodate five stations, into which the wires have been led. The printing circuit is to be provided with three instruments—two terminal, one intermediate—whilst the train-signals are made use of at huts erected one to every five miles of line.

Of course, were all circuits to be fitted up at once, the batteries, instruments, &c., for each station should be all sent off together in charge of a man in whom you can place reliance, to be deposited by him each at their respective station; but for convenience and clearness in explaining their different connections we prefer to take each circuit by itself.

The line wire is 80 miles in length, of No. 8 wire, and gives we will say a resistance of 40 miles. Each instrument will add 20, so that we may reckon the total resistance of the circuit as 140 miles. Four intensity batteries will be sufficient to work the circuit. Let them be got together and, with the instruments, labelled, and sent on to their respective stations. We must not forget to test each instrument before starting it. This is done by connecting up a battery to the two front terminals—zinc to Z and copper to Y—and joining the remaining two terminals, A B and C D, on either side together. The instrument is then on short circuit, and whatever signals are made by means of the handles should be recorded by the needles. Time is of importance at all times, but especially so on a railway, where the loss of a minute may, perhaps, detain you some hours. Consequently, if the batteries are supplied with their plates and sulphate of copper previous to their despatch, it may prove of advantage. Each copper cell should be supplied with about two ounces of sulphate of copper, sufficiently bruised to admit it with ease within the cell. If you require the battery for immediate use a little sulphate of zinc deposited in the zinc cells will quicken its action. A few drops of sulphuric acid will afford us like assistance.

The lineman who is to have charge of the length should be present when the instruments are joined up, that he may himself see all joints are well made and securely covered. It is manifestly to his own interest to look to all these things at the outset. Let him, therefore, accompany you. As we pass down the line, at each station where an instrument is to be put in circuit we hand out the necessary articles. Arrived at the distant or terminal station we set to work, and whilst one is looking to the batteries, filling each cell to within an inch of the top with water, the inspector may be joining up the instrument. The batteries should have provided for them a closet or other secure place, where they are not likely to be interfered with. At large stations it is usual to have a room devoted entirely to the batteries, where, arranged upon racks, each separate set is marked according to the circuit upon which it is employed. In joining them up we have simply to connect the zinc pole of the one to the copper of the other, leading the terminating wires of the whole set, zinc and copper, up to the instrument, connecting them to their respective terminals, usually copper to the right-hand front terminal (marked Y), and zinc to the left-hand (marked Z).

(To be contir

MAURITIUS ON THE INFLUENCE OF HEAT ON MAGNETISM.

Dr. Mauritius, of Marburg, has communicated to *Poggendorff's Annalen* the results of a series of experiments instituted by him with a view to determine the influence of heat on bar magnets. The subject has been previously investigated by Wiedemann (*Pogg. Annalen*, vol. c. p. 241, and ciii. p. 563); and it was partly to check the results obtained by him that Dr. Mauritius undertook the researches of which we are about to give a short account.

The first part is devoted to a description of the effects produced by alternately heating and cooling magnetized bars from 212° to 32°, and is little more than a repetition of the experiments of Wiedemann, to which we have previously referred, the results of which, however, are not on all points confirmed by Dr. Mauritius.

The second and more interesting part describes a series of experiments on temporary magnetism at very high temperatures—a subject which is touched upon by Barlow in his "Essay on Magnetic Attractions." The object which Dr. Mauritius had in view was to ascertain the coercive force of iron and steel of various qualities at elevated temperatures; and for this purpose he made use of the following arrangement of apparatus:—An ordinary electro-magnetic coil, 8½ inches in length, and consisting of five layers of copper wire of ·078 inch in diameter, was placed perpendicular to the magnetic meridian, and in the same horizontal plane with a delicately-poised magnet ·23 inches diameter and 2·3 inches long. This was suspended by a single thread, consisting of two fibres of silk about 3 feet in length, and was furnished with a mirror in the usual manner, the deflection being read off by means of a telescope, on a scale divided into millimètres, and situated at a distance of 3 feet 6 inches from the magnet.

The method of bringing the magnet to rest, after each observation, was ingenious, and is claimed by Dr. Mauritius as novel. At a suitable distance in front of the needle he placed a coil of copper wire, having its axis east and west, and through which, by means of a commutator of simple and, indeed, almost primitive construction, he sent a current in the direction necessary for checking the vibration of the magnet. By the use of this he was enabled to make sixteen separate observations in the short space of half-an-hour. The commutator was constructed by driving three nails into a board, so as to form an equilateral triangle, the nail at the apex being much larger than the other two, and driven through and clenched on the other side of the board. The large nail was also bent twice at right angles, so as to form a sort of handle, by which it might be brought into contact with either of the small nails at the base of the triangle. When left to itself, it hung freely between the two. The battery consisted of two pairs of plates excited with weak acid, the zinc pole of one pair, and the copper pole of the other, being each connected with one of the smaller nails. The two remaining plates were connected with each other, and also with the large nail. It will be apparent, from this description, that the current would be reversed by moving the large nail from one to the other of the small ones. By simply releasing it, the weight of the nail causes it to assume a position midway between the other two, and the circuit is broken.

The bars experimented upon were four in number, and were all about six inches in length, the first being of wrought iron, the second of English cast steel, and the third and fourth of cast iron. They were, first of all, heated to a white heat, and then placed carefully within the coil, contact with the battery having previously been made. Some time elapsed in all cases after the introduction of the bar into the coil, before any motion of the magnet took place, but the steel bar behaved in the most remarkable manner. For a short time it produced no effect upon the needle, but, when it had cooled down to a certain point, it suddenly became magnetic, the magnetism increasing gradually with the falling temperature. This increase went on for some time, until at length the needle again remained stationary for a short period, at the end of which the phenomenon of the sudden appearance of the magnetism was repeated, and the magnetism increased in quantity until it attained its maximum. The same irregularity occurred, to some extent, in all the bars experimented upon, but less in the cast than in the wrought iron.

It is apparent, therefore, from these results, that the coercive power does not decrease gradually with the fall in temperature, and that there is a point above which no magnetism is communicated to the iron. When the heat sinks to this limit, the

magnetism appears suddenly, and goes on increasing until we arrive at a second interval, during which the needle remains perfectly stationary. As the temperature still decreases, the same phenomenon is repeated, and the magnetic power increases until it attains its maximum. On account of the many difficulties attendant upon the determination of very high temperatures, he does not attempt to fix the point at which iron becomes susceptible of magnetic excitation, but, by cooling a bar in water, he found it to be about 1000° C.

Dr. Mauritius infers from this that iron and steel are incapable of being magnetized when at a white heat, and mentions, *en passant*, that Faraday has already shown that they do not assume the dia-magnetic condition under similar circumstances. After having remarked upon the insufficiency of any of the present theories of magnetism to explain the phenomena which he has pointed out, he attempts to account for the sudden appearance of the magnetism, when the bar has cooled to a certain temperature, in the following manner:—"I look upon iron has having a binary composition (Fe + Fe), and that this binary character is somehow connected with its magnetic properties. At very high temperatures the double atoms become separated, and magnetism ceases. This occurs at a certain fixed point, and, when the temperature has sunk below this point, the atoms recombine and magnetism begins. The manifestation of the presence of the magnetism, as seen through the telescope, is as though a chemical change were being propagated through a compact mass: witness the formation of sulphuret of iron. When the double atoms have become separated, the iron is in a nascent state. I anticipate no objection, on chemical grounds, when I instance the decomposition of water by red-hot iron. The property of welding may also be explained on a similar hypothesis."

Dr. Mauritius is not prepared to give a satisfactory explanation of the non-continuity of the magnetism, so especially marked in the case of steel; but he imagines that it is in some way connected with the presence of carbon. As was first shown by Karsten, the carbon in hardened steel is chemically united with the iron; but this is not the case as regards soft steel. After a careful consideration of these and some other similar facts, he seems inclined to think "that the presence of carbon in steel, at this temperature, induces a wide-spread chemical or molecular change, which is less apparent in cast iron, and disappears altogether in the case of wrought iron.

THE IDENTITY OF LIGHTNING AND ELECTRICITY.

The mode in which this great discovery was suggested to Dr. Franklin, we give in his own words, extracted from his autobiography:—

"In 1746, living then in Boston, I met with Dr. Spence, who was lately arrived from Scotland, and showed me some electrical experiments. They were imperfectly performed, as he was not very expert; but, being on a subject quite new to me, they equally surprised and pleased me. Soon after my return to Philadelphia, our library company received from Mr. Peter Collinson, Fellow of the Royal Society of London, a present of a glass tube, with some account of the use of it, in making such experiments. I eagerly seized the opportunity of repeating what I had seen in Boston; and, by much practice, acquired great readiness in performing those also which we had an account of from England, adding a number of new ones. I say much practice, for my house was continually full, for some time, with persons who came to see those wonders.

"To divide a little this encumbrance among my friends, I caused a number of similar tubes to be blown in our glass-house, with which they furnished themselves, so that we had at length several performers. Among these the principal was Mr. Kinnersley, an ingenious neighbour, who, being out of business, I encouraged him to undertake showing the experiments for money, and drew up for him two lectures, in which the experiments were ranged in such order, and accompanied with explanations in such method, as that the foregoing should comprehend the following. He procured an elegant apparatus for the purpose, in which all the little machines that I had roughly made for myself were neatly formed by instrument-makers. His lectures were well attended, and gave great satisfaction; and after some time he went through the colonies, exhibiting them in every capital town, and picked up some money. In the West India Islands, indeed, it was with difficulty that the experiments could be made, from the general moisture of the air.

"Obliged as we were to Mr. Collinson for the tube, &c., I thought it right he should be informed of our success in using it, and wrote him several letters containing accounts of our experiments. He got them read in the Royal Society, where they were not at first thought worth so much notice as to be printed in their *Transactions*. One paper, which I wrote for Mr. Kinnersley, on the sameness of lightning with electricity, I sent to Mr. Mitchell, an acquaintance of mine, and one of the members also of that society; he wrote me word that it had been read, but was laughed at by the connoisseurs. The papers, however, being shown to Dr. Fothergill, he thought them of too much value to be stifled, and advised the printing of them. Mr. Collinson then gave them to Cave, for publication in his *Gentleman's Magazine*, but he chose to print them separately in a pamphlet, and Dr. Fothergill wrote the preface. Cave, it seems, judged rightly for his profession, for by the additions that arrived afterwards, they swelled to a quarto volume, which has had five editions, and cost him nothing for copy-money.

"It was, however, some time before those papers were taken notice of in England. A copy of them happening to fall into the hands of the Count de Buffon, a philosopher deservedly of great reputation in France, and indeed all over Europe, he prevailed with M. Dubourg to translate them into French; and they were printed at Paris. The publication offended the Abbé Nollet, Preceptor in Natural Philosophy to the Royal Family, and an able experimenter, who had formed and published a theory of electricity, which then had the general vogue. He could not at first believe that such a work came from America, and said it must have been fabricated by his enemies at Paris to oppose his system. Afterwards, having been assured that there really existed such a person as Franklin at Philadelphia, which he had doubted, he wrote and published a volume of letters, chiefly addressed to me, defending his theory, and denying the verity of my experiments, and of the positions deduced from them.

"I once purposed answering the Abbé, and actually began the answer, but, on consideration that my writings contained a description of experiments which any one might repeat and verify, and if not to be verified, could not be defended, or of observations offered as conjectures, and not delivered dogmatically, thence not laying me under any obligation to defend them, and, reflecting that a dispute between two persons, written in different languages, might be lengthened greatly by mistranslations, and thence misconceptions of one another's meaning—much of one of the Abbé's letters being founded on an error in the translation—I concluded to let my papers shift for themselves, believing it better to spend what time I could spare from public business in making new arrangements, than in disputing about those already made. I therefore never answered M. Nollet, and the event gave me no cause to repeat my silence, for my friend, M. Le Roy, of the Royal Academy of Sciences, took up my cause and refuted him; my book was translated into the Italian, German, and Latin languages, and the doctrine it contained was by degrees generally adopted by the philosophers of Europe, in preference to that of the Abbé, so that he lived to see himself the last of his sect, except Monsieur B——, of Paris, his *élève* and immediate disciple.

"What gave my book the more sudden and general celebrity was the success of one of its proposed experiments, made by Messieurs Dalibard and De Lor at Marly, for drawing lightning from the clouds. This engaged the public attention everywhere. M. De Lor, who had an apparatus for experimental philosophy, and lectured in that branch of science, undertook to repeat what he called the 'Philadelphia Experiments,' and, after they were performed before the king and court, all the curious of Paris flocked to see them. I will not swell this narrative with an account of that capital experiment, or of the infinite pleasure I received in the success of a similar one I made soon after with a kite at Philadelphia, as both are to be found in the histories of electricity.

"Dr. Wright, an English physician, when at Paris, wrote to a friend, who was of the Royal Society, an account of the high esteem my experiments were in among the learned abroad, and of their wonder that my writings had been so little noticed in England. The Society, on this, resumed the consideration of the letters that had been read to them, and the celebrated Dr. Watson drew up a summary account of them, and of all I had afterwards sent to England on the subject, which he accompanied with some praise of the writer. This summary was then printed in their *Transactions*,

and some members of the Society in London, particularly the very ingenious Mr. Canton, having verified the experiment of procuring lightning from the clouds by a pointed rod, and acquainted them with the success, they soon made me more than amends for the slight with which they had before treated me. Without my having made any application for that honour, they chose me a member, and voted that I should be excused the customary payments, which would have amounted to twenty-five guineas, and ever since have given me their *Transactions* gratis. They also presented me with the gold medal of Sir Godfrey Copley, for the year 1753, the delivery of which was accompanied by a very handsome speech of the president, Lord Macclesfield, wherein I was highly honoured."

Dr. Franklin afterwards, in a letter to a friend in England, gave a full account of his experiment with the kite:—

"While he was waiting for the completion of a spire which was being erected in Philadelphia, it occurred to him that he might raise a lightning-rod in the air by means of a kite. He accordingly constructed a light cross of cedar wood, which he covered with a large, thin silk handkerchief. Into the upper end of the kite he inserted a pointed wire about a foot in length, and connected this with a string which was of hemp. The lower end of the string was terminated by a silk cord, and at the junction of the hemp and silk was attached an iron key. He then waited for the approach of a thunder-shower, and seeing a cloud arising, he took his son with him, and going out of the city raised his kite. For a considerable time there was no manifestation of electricity, the cloud passing over the kite without producing any effect, and he began to despair of success. After a time, however, he saw the fibres of the hemp string bristling out, and, presenting his knuckles to the key, he received a spark. After it began to rain and had wet the string, increasing its conducting power, the sparks came in profusion."

This experiment was made in June, 1752, and Franklin was then forty-six years of age. Though similar experiments had been made just previously, by Dalibard and De Lor, in France, yet, as those were made in accordance with directions furnished by Dr. Franklin, the credit of the discovery is fully awarded to him by the most eminent French writers, including De la Rive.

The discovery immediately attracted universal attention, and the experiment was repeated throughout Europe. In St. Petersburg it cost one learned professor his life. Professor Richman was engaged in writing a work on the electricity of the atmosphere, and had erected a lightning-rod on his house. In the forenoon of August 6th, 1753, he was attending a regular meeting of the Academy of Sciences, when he heard distant thunder, and immediately hastened home to observe his rod, taking with him his engraver, Sokolow, to witness the phenomena, so that he might be able to represent them. The lower end of Professor Richman's rod terminated in a glass jar, and he had attached a light string to the rod to indicate the degree of electrical excitement. The string was standing at 4°, and Professor Richman was explaining to Mr. Sokolow the extreme danger if it should rise to 45°, when there came a terrible clap of thunder, that startled all St. Petersburg. Professor Richman stooped down to look at his electrometer, when, Mr. Sokolow says, a ball of fire, as big as his fist, darted from the rod into the professor's head. He fell back dead. A red spot was found on his forehead, the shoe of his left foot was split open, and the skin was burned in a few places on his body.

Dr. Franklin immediately turned his thoughts to the application of his great discovery to some useful purpose, and suggested the lightning-rod, by which the thunderbolt is drawn in silence from the clouds, and the most dreaded of all the forces of nature is robbed of its terrors.

Improved Lightning-rod.—This form of lightning-rod is of the non-insulated class, and is constructed of pure cold-rolled Lake Superior copper. The conductor itself is of a flat form, and is fastened in close contact with the building it is intended to protect. It is continuous in length, and is supported at various intervals by straps of the same material nailed to the house, the ends of the straps being turned over to make a neat appearance. The upper portion of the rod may be coiled up in a tubular form, to compose the tip and point; the flat shape also permits the conductor to be easily rolled up for transportation. The fact of this conductor being continuous throughout its entire length, without a joint, is a valuable feature, as electricity passes over a smooth surface much more readily than where joints or breaks occur. The close connection between the conductor and the building, the inventor states, is a safeguard against ascending as well as descending currents, and it is claimed that the general arrangement of this continuous non-insulated conductor is safer—much more convenient for adjustment and transportation—than those ordinarily in use.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 235.)

M. Gloesener, Liége, M. (Belgium, 349), exhibits a chronoscope, in which many of the difficulties attending these delicate instruments have been successfully overcome. He avoids the use of soft iron altogether, and marks the instant at which the current ceases to pass through a given circuit by means of a sensitive galvanometer. One end of the needle of this galvanometer is provided with a little point, which, when the circuit is broken, is brought for an instant into contact with the blackened surface of a revolving cylinder. The very deflection of the needle, however, re-establishes the current through a second circuit, and lifts the point away from the revolving cylinder, leaving a little speck as the mark of the instant at which the needle fell. The moment at which the second circuit is broken can be similarly registered, and the current is instantly established in a third circuit, which in its turn can serve for a third observation. The little point at the end of the galvanometer needle is so arranged as to make a differently-shaped mark on its first deflection to that which it subsequently produces. This is done to mark the starting point. The cylinder, coated with lamp-black, revolves rapidly, making about four revolutions per second. Another cylinder, geared with the first, and revolving much less rapidly, is marked at the same instant by a second galvanometer needle. The marks on the first cylinder show the fractions of less than one quarter of a second, separating two observations; and the marks on the second cylinder show whether more than one quarter of a second has elapsed between the two observations, and if so, how many. The first cylinder is divided into 500 parts, and allows of approximate measurement to the 10,000th of a second. The speed is controlled by a fly aided by a governor, in which two diverging balls, such as are used in Watt's governor, lift one end of a set of jointed levers, the other end of which presses a small spring against one end of the revolving cylinder. It is said that this method of governing the speed gives sufficiently accurate results, and it is certainly not without merit. The divergence of the balls is, it will be observed, quite unaffected by the use made of the spring to retard the movement: a condition favourable to uniformity of motion, generally, if not always, neglected hitherto. The apparatus is driven by a weight of twenty kilogrammes, and remains in motion for about twenty-five minutes. The marking point of the galvanometer is placed about one millimetre distant from the revolving cylinder. The needle is light, so that it can be made to fall and rise with great rapidity by a small force; and, moreover, on the cessation of the current, its fall will occupy sensibly the same time on different occasions. The defects arising from the use of soft iron are thus entirely avoided.

M. Gloesener exhibits several ingenious arrangements, by which the current can be re-established in fresh circuits after each interruption; but this part of the mechanism may be varied almost indefinitely. The initial speed of bullets can be shown on this apparatus by the fracture of wires placed within two or three yards of one another, so rapidly does the galvanometer point fall and rise.

M. Gloesener also exhibits another chronoscope of much simpler construction, which seems extremely well adapted for experiments, in which the time to be measured does not exceed about one quarter of a second. This instrument consists of a galvanometer similar to that already mentioned, leaving its marks on a divided limb, forming part of the bob of a pendulum. It resembles Navez's instrument, inasmuch as the time separating the two marks is required to be deduced from the period of oscillation of the pendulum, but differs from it considerably, inasmuch as the observations are registered directly instead of indirectly. Moreover, it dispenses with soft iron, and allows two or more events to be registered during one oscillation of the pendulum.

T. Jaspar, Liége, H. M. (Belgium, 350), exhibits a chronoscope known as Navez's pendulum chronoscope, an instrument extensively used both abroad and in this country. This apparatus consists of three distinct parts. 1st. The pendulum with its immediate accessories. 2nd. An apparatus for making a contact at a given time after a certain circuit has been broken. 3rd. An apparatus for breaking two circuits simultaneously. These two last parts may be simply called the contact-maker and contact-breaker.

The pendulum is fitted with two electro-magnets—one used to hold it at one extremity of its oscillation by attracting a little piece of soft iron let into the bob; the other, to stop a very light aluminium index centred on the axis of the pendulum, and carried round with

it by the light friction of a spring, until a current passes round this second electro-magnet, which then stops the index by attracting an iron collar fitted to its hollow axis, but allows the pendulum to continue its oscillation freely. A vernier on the end of the index allows the exact arc described in passing from the first to the second position of rest to be accurately read on a fixed graduated limb. Thus the interruption of a current through one circuit starts the pendulum and index simultaneously, and the establishment of a current in a second circuit stops the index, showing the arc traversed in the interval. It will readily be understood that the velocity of the pendulum, in falling through various arcs, can be determined by direct experiment.

The speed of the projectile in this as in other chronoscopes is measured by the time elapsing between the successive fractures of two wires, but in the present case the measurement is indirect. The nearest wire screen forms part of a circuit which includes the electro-magnet used to restrain the pendulum, but the farther wire screen is not directly connected with either of the pendulum electro-magnets, but it is connected with the electro-magnet of the contact-maker. This electro-magnet carries an armature, which drops off when the circuit is broken, and falls on to a spring furnished with a contact point, adjusted close to the surface of some mercury in a little cup. The fall of the armature makes contact between the mercury and the spring, and by so doing completes a circuit through the second electro-magnet of the pendulum, and stops the index. Thus, when a ball passes through the two wire screens in succession, it first breaks the first circuit, and starts the pendulum; it next breaks the second circuit, and lets fall an armature, which completes a third circuit, and stops the index. The arc can then be measured, which corresponds to the time elapsing between the moment when the pendulum started and that when the index stopped. But this period of time depends on many elements: 1st. The time required by the first electro-magnet to lose its magnetism. 2nd. The time required by the electro-magnet of the contact-maker to lose its magnetism. 3rd. The time occupied by the fall of the armature. 4th. The time required by the second pendulum electro-magnet to acquire sufficient force to stop the index; and 5th. The time of flight between the two screens. The contact-breaker is used to eliminate by a separate observation the first four of these elements, leaving the fifth, which is alone required. This is simply and easily effected by establishing all the circuits as before, and breaking the two wire screen circuits simultaneously. All the events will occur in the same sequence as before, except the rupture of the two circuits, and as all the other circumstances remain similar, they will occupy in the aggregate exactly the same time as they must have done in the previous experiment, and the index will be arrested after it has traversed an arc B, measuring their duration; if, then, A be the arc traversed in the former experiment, the difference, A — B, will measure the time of flight between the screens in the first observation. This measurement is required to be reduced into seconds by calculations of an obvious character.

The great merit of this chronoscope has been proved by its extensive use; but it is difficult to believe that it can give thoroughly accurate results. The calculation of the time occupied by the bob in traversing each part of the limb takes no account of the friction or of the resistance of the air. It is difficult to observe accurately the elements required to calculate this period of oscillation. Electro-magnets are seldom in the same condition, even during two successive experiments, and no less than three electro-magnets are required in this apparatus. There is always some risk that the contact-breaker may not break the two circuits at exactly the same moment. The friction employed to carry round the index may be too small, and the index will then lag behind the pendulum at starting, or the friction may be too great, and drag the soft-iron collar or the index past the electro-magnet some uncertain time after its circuit is completed. Nevertheless, this instrument is in great repute, probably owing to the simple plan of referring the velocity of the projectile directly to the velocity of a pendulum; but it certainly seems probable that the apparatus would be much improved by dispensing with all the electro-magnets, contact-makers and breakers, with the substitution of a direct observation recorded by an induction spark as in Hardy's chronoscope, or by a galvanometer needle such as M. Gloesener adopts.

The galvanometer chronoscope used by M. Pouillet and by M. Helmholz is, unfortunately, not represented in the Exhibition.

7. *Chronographs.*

Chronographs may be described as chronoscopes, in which the times registered depend on a signal sent by the voluntary effort of the observer, instead of by the automatic action of the apparatus.*

The Telegraphen Werkstätte of Berne (Switzerland, 151) exhibit a chronograph for registering the instant at which any observation is made—for instance, the passage of a star.

A strip of paper is moved along by clockwork, driven by a weight, and governed by a fly. The latter is so arranged, that on any slight increase of speed, the axis of the fly is pressed against a steel spring, increasing the friction, and acting as a break. The strip of paper is permanently pressed against two little revolving discs placed side by side, and receiving ink from felt rollers, as in Digney's ink-writer. These two discs, when not interfered with, produce two straight parallel lines side by side on the paper. Two electro-magnets, with two distinct circuits, are used, with armatures so connected with the supports of the two revolving discs, that a momentary current sent round either magnet moves the corresponding disc a little way across the paper, making a little nipple on one of the black lines. The pendulum of a clock closes the circuit of one of the electro-magnets once every second, and nipples are consequently produced on one line, separated by lines representing seconds of time. The circuit through the other electro-magnet is completed at any required moment by the observer with the aid of a common contact key. The nipples so produced on this line, by comparison with those on the first, fix the time of each observation recorded. The "second" nipples are about ten millimetres apart, and intervals of time of less than one-tenth of a second can therefore be accurately shown by this instrument.

H. Ausfeld, Gotha, M. (Saxe-Coburg, 2,625), exhibits a similar apparatus for registering astronomical observations, which differs from the last described in detail only. This instrument consists of clockwork used to draw forward a strip of paper, and regulated roughly by a centrifugal pendulum. Two electro-magnets are used with their armatures; one, worked by pendulum contacts from an astronomical clock, marks the seconds by dots on the paper; the other makes a dot by the side of the former when a button is pressed by the observer at the instant of an observation. The relative position of this dot with the others marks the time of each observation. The observer has also the means of stopping the clockwork at will, and starting it by an electric current at any given moment. This instrument was designed by Dr. A. Hansen, and is used in the Gotha and Leipsic observatories.

An excellent electric chronograph is also exhibited by M. Krille, Altona, Class XV. (Denmark, 136). This instrument arrived too late to be inspected by the jury, or, in the writer's opinion, a medal would certainly have been awarded to the exhibitor. In this instrument a cylinder covered with blackened paper, driven by clockwork, and regulated by a conical pendulum like that in Hardy's chronoscope, revolves at sensibly uniform speed. Two diamond points on the ends of two levers are pressed against the cylinder as it revolves, and mark two fine white lines on the blackened surface. These levers are carried on a sort of car, to which a slow motion of translation is given parallel to the axis of the cylinder, so that the lines marked are helical and continuous. The levers are, moreover, connected with the armatures of two separate electro-magnets, also carried on the car. These armatures, by their motion, can produce a slight independent movement of translation in the diamond points along the surface of the cylinder. One of these electro-magnets is worked by contacts from a standard clock, so contrived as to produce a broken line equally subdivided, thus ‾|_|‾|_|‾. The instant of the change of contact is thus singularly well and sharply defined. The second electro-magnet is worked by the observer with a key, and produces a little nipple, fixing the instant of observation by its position on the cylinder relatively to the broken or "second" line. So far the arrangements, although extremely good, can hardly be called novel. The manner of obtaining the contacts from the standard pendulum is, however, not only excellent, but, so far as the writer knows, quite new. Two short vertical glass tubes placed side by side have each near their lower end a small horizontal branch, the two open ends of which are placed in very close proximity opposite each other. The two larger tubes are partly filled with mercury, which flows through the two horizontal branches until the two streams join in the open space between them. This space is, however, so small that capillary attraction

* The writer drew this distinction between the words chronoscope and chronograph from the consideration that the one instrument is used to observe a certain short interval of time, and the other to write or record the time at which a certain phenomena occurs. Professor Wheatstone has pointed out to him that a different distinction was drawn in the original use of the words. Chronoscope was then used to signify an instrument by which the interval of time could be observed, and chronograph an instrument by which it could be recorded.

prevents the mercury from falling down, so that it is entirely retained inside the tubes, with the exception of this one short, exposed, and apparently unsupported drop hanging between the two branches. A very thin sheet of mica is carried by an arm on the pendulum, so placed that at each beat the mica sheet descends between the ends of the two little branch tubes, separating the mercury in the two reservoirs, and breaking all electrical connection between them. At the return of the pendulum the mica sheet is withdrawn, and the mercury from the two sides joins as before, making an electrical connection. The action of this admirable make and break arrangement seems all that could be desired; the mercury is not spilt, as might be expected, and the contact appears to be made with perfect certainty and regularity. The friction must be almost nothing; and if, as appears probable, the oxide formed by each spark is removed by the mica plate in its descent, this plan might be very advantageously applied to all electric clocks and galvanometer relays. The workmanship of the instrument is excellent.

Mouilleron & Vinay, Paris, M. (France, 1,438), exhibit a chronograph of apparently very complicated construction. The writer was unable to obtain any description of this instrument.

8. *Electric Lamps.*

A considerable number of self-acting regulators for the electric light are exhibited. Carbon electrodes are used in all these lamps, and the general object aimed at is the maintenance of a constant current through these electrodes. In all, the current is passed round an electro-magnet, the armature of which allows the approach of the two carbon points when the strength of the current falls below a certain amount. The resistance of the circuit is thus diminished, and the current re-established at the desired strength. As the points are consumed the resistance again increases, the current is weakened, and the armature allows of a further approach. In some of the lamps provision is made for separating the electrodes when the current is too strong. It is clear that this principle will never lead to perfect constancy in the light, so long as any variation occurs in the electro-motive force of the source of electricity employed, or where great variations occur in the resistance, or composition of the carbon electrodes; for instance, it is clear that, in order to allow equal currents to circulate with a weak and strong battery, they must remain very slightly separated in the first case, and at a considerable distance apart in the second case. The light under these two conditions cannot be the same. Nevertheless, convincing proof has been given that where the source of electricity is sensibly constant, as is the case with a magneto-electric engine driven at a constant speed, the light may with electrodes of good quality be maintained sensibly constant.

L. J. Duboscq, Paris, M. (France, 1,420), exhibits a lamp which is extensively used for optical experiments.

The two carbon electrodes are fixed one over the other, on frames connected by racks and gearing, so that when the upper electrode descends, the lower one rises. The wheelwork is so arranged, that the relative motion of these two electrodes shall be such as to compensate for the well-known unequal consumption of the positive and negative carbon electrodes. The light is maintained in a constant position by this arrangement, which would not be the case if only one electrode were moveable, and the other fixed, or if the two moved through equal distances; a barrel spring is employed to drive the clockwork which moves the electrodes. This clockwork is stopped by a detent which gears with an escapement wheel. The detent is connected with the armature of an electro-magnet, and allows one or more teeth of the escapement wheel to pass whenever the current is below a certain strength. Thus, step by step the carbon points are allowed to approach. In order to light this lamp one of the carbon electrodes must be brought in contact with the other by hand, and then removed to a certain distance; this can be done without interfering with the train of wheels. The distance from each other at which the electrodes remain, or rather the strength of current at which the escapement wheel is freed, can be regulated by altering the distance between the electro-magnet and its armature, and thus altering the attraction between them for a given current.

This lamp is said to answer excellently for experiments, or for the lecture-room; it is not suited to lighthouses or for public lamps, because, if extinguished by any accident, it is not spontaneously relighted. It moreover requires to be stopped as well as started by hand, otherwise the carbon sticks would be forced together by the clockwork until they become jammed or broken.

M. Duboscq exhibits another lamp of very similar construction, in which only one of the two electrodes moves, and the light, therefore, gradually changes its position.

J. Jaspar, Liége, H. M. (Belgium, 350), exhibits a very simple form of regulator.

The electrodes both move, and are so connected by cords and pullies that their relative motion is in proportion to their consumption. The weight of the upper frame and electrode is somewhat greater than that of the lower frame, and when slightly loaded, is used to put the system in motion; a soft-iron cylinder attached to the lower frame enters for about half its length into a suction coil. When the current attains a certain strength, the suction produced in this coil, added to the weight of the lower frame, exactly counterbalances the weight of the loaded upper frame and electrode, and the further approach of the electrodes is stopped; but as these wear away, the soft-iron core rises slowly in the suction coils, so as to maintain a nearly constant strength of current. In this form there is no intermittence in the light, which, moreover, remains sensibly in one spot. It must, however, be lighted by hand, by first bringing the two points together, and then separating them. Moreover, the current cannot remain perfectly constant, for the attraction produced by a given current on the soft-iron cylinder varies as this cylinder rises in the coils. The adjustment by which the distance of the points or the strength of current is determined is made by simply adding or removing small weights, such as shot, to or from the top or driving frame. Any change in the friction of the moving parts would require a fresh adjustment of this weight. The lamp has, however, the merit of extreme simplicity.

(To be continued.)

THE TELEGRAPH IN SPAIN.

In a recent number we alluded to the great zeal with which, amongst other well-considered measures, the Minister of Spain is endeavouring to forward all matters connected with telegraphy. We have now much pleasure in publishing the following papers, shewing what has already been achieved for telegraphy, the increase of free intercourse, the progress of commerce, and the welfare of that nation. We congratulate the young Minister, Senor Antonio Cánovas del Castillo, who so well understands how to develope all matters connected with the prosperity of his country, and let us render him the honour to which he is so much entitled, in order to encourage him to continue in office, which his excessive modesty has made him shun so often, but in which he daily gives evidence of administrative capacity of high order.

Petition to Her Majesty.

Madam,—For some time past your Majesty's Government has been endeavouring by various means to place telegraphic correspondence on such a footing of facility and economy, as to make it correspond with its important objects and the wishes of the public.

There are still several important measures to be adopted, and the government proposes to study and establish them as speedily as possible.

The surcharge of a real for each inland telegram, known as porterage, the profit of which is applied, by Royal order, to provide for the deficiency of the salaries of clerks charged with the maintenance of lines and service of the stations, forms an obstacle to the development of the telegraphic service, in spite of the smallness of its amount. The government being convinced of this, has taken care in the present budget, submitted to the Cortes, to suggest the necessary alterations, so that, without burdening the treasury, but rather assisting it by means of a new organization of the service, in which considerable economy has already been decreed, they may be able to suppress this tax upon correspondence, and obtain a sensible reduction in the cost of inland telegrams, a perfect harmony and simplicity in the tariffs, regulating them strictly according to the length of each despatch, an exact uniformity between the regulations and cost of Spanish inland correspondence, and those which govern the international communications, and lastly, what is more important still, the disappearance of the principal obstacle against establishing the system of franking by stamps instead of actual payment of telegrams.

This measure, then, accompanied by the new organization applied to the service of transmission, and, by the latitude granted by Royal decree, dated the 30th of March, will surely increase the facilities claimed by the public, for utilising the telegraph, and will greatly assist in diminishing the deficit which weighs so heavily upon this important branch of public administration.

For these considerations the Minister hereto subscribing has the honour of submitting to your Majesty the annexed proposed decree.

At your Majesty's R. F.,

Antonio Cánovas del Castillo.

ROYAL DECREE.

In conformity with what the Minister of State has proposed to me, I have decreed as follows :—

Art. 1. From the 1st of next May the extra fee for porterage, with which the inland correspondence is surcharged, will cease.

Art. 2. The cost of such telegrams will from the 1st of July be reduced to the uniform rate of four reals for every message of ten words.

Done at the Palace, on the 21st day of April, 1864.

I THE QUEEN.

The Minister of State for Home Affairs,
Antonio Cánovas del Castillo.

MINISTRY OF STATE.

Arrangement entered into between Spain and France for equalising and diminishing the rate of the present tariff of prices for transmission of telegraphic messages.—Signed in Paris on the 30th day of December, 1863.

The Government of Her Majesty the Queen of Spain and the Government of His Majesty the Emperor of the French, anxious to obtain for their respective countries the advantages of an equalised tariff for transmission of telegraphic messages, and with the view of increasing them by reducing the price, have for that purpose given authority to the undersigned, the Ambassador of Her Catholic Majesty the Queen of Spain and the Minister of Foreign Affairs of His Majesty the Emperor of the French, who have agreed to the following terms:—

All the despatches which will pass through Spain (including the Balearic Islands) and France (including Corsica) will pay the rate of four francs per message of twenty words, no matter from what telegraphic office they proceed, or to what station they are addressed. Each ten words, or part of ten words, beyond twenty, will pay half the amount of a single message.

The amount of every message will be divided equally between the two Governments.

It is also agreed that if, in consequence of any interruption of the direct submarine communication between France and Corsica, it should be necessary to transmit the messages from Spain to that island through a foreign line, they should, in respect of payment, be subject to the general conditions of existing international treaties.

The conditions established by the decree dated 29th of April, 1859, respecting the cost of these messages transmitted on the frontier from one station to another, are repealed.

The cost of a single message transmitted from France to Algeria, or *vice versa*, passing through the Spanish or submarine lines, as also of the messages between Spain and Algeria, transmitted either by land or French cables, will always be eight francs. The messages received or forwarded to Tunis will pay two francs more.

The amount of these messages will always be divided in the proportion of three francs to Spain, and five or seven francs to France, according to whether the despatch be to Algeria or to Tunis.

The messages exceeding twenty words will have to pay an extra charge, in accordance with the rule already established.

To avoid the difficulties which might occur in consequence of the different coinage of the two countries, it has been agreed that the international accounts, made up in the usual form, shall be presented by Spain in Spanish figures, but at the same time its amount reduced into French figures; and by the French administration in French money, also reducing the amount into Spanish figures.

The reduction of the money will be made at the rate of nineteen reals vellon for every five franc piece.

So far as inconsistent with the present act are repealed the conditions of the ninth article of the decree signed on the 24th December, 1863, which runs thus :—

"The submarine communication from Oran to Carthagena will have to pay one franc fifty cents for messages forwarded either from Spain or Portugal to Algeria."

This agreement is established for an indefinite period, and will last until denounced by either of the contracting states; in that case it will continue in operation a year beyond the date of such denunciation.

The stipulations of this agreement will come into operation on the 1st of January, 1864.

The present agreement will be ratified, and the ratifications will be exchanged in Paris as soon as possible.

Done in duplicate, in Paris, on the 30th of December, 1863.

(L. S.) Signed, TAVIERDE ISTURIR.
(L. S.) Signed, DROUYN DE LHUYS.

This agreement has been duly ratified by Her Catholic Majesty and by His Majesty the Emperor of the French, and the ratifications were exchanged in Paris on the 8th of the present month of April.

MAGNETIC GLOBE.—This is a new and ingenious invention by Mr. Elbert Pere, of Brooklyn, N.Y., and consists in the production of geographical globes with magnetic powers, by making them of a metal possessing magnetic properties, so that small objects, also possessing magnetic properties, will be attracted and adhere to the surface of the globe, and thus enable the illustration to the eye of the principle of the power of the earth's attraction —a physical fact which teachers have heretofore found difficult to demonstrate successfully to the minds of the young.

LIGHTING GAS BY ELECTRICITY.

MANY attempts have been made from time to time to effect the simultaneous ignition of a great number of gas-jets by the aid of electricity. Thus, all the lamps, not alone in a single street, but in an entire district, might be lighted in a single instant of time, and, in addition to the convenience of such an arrangement, an actual saving of gas would be effected, because, now, certain lamps have to be lit too early in order that others may not be lit too late. In theatres, concert-rooms, churches, &c., it is obvious that great advantages would follow on the successful employment of any system of electrical simultaneous ignition.

Hitherto this has been proposed to be effected by a wire running from jet to jet, the circuit being partially interrupted by the introduction of a filament of platinum in proximity with the orifice through which the gas issues. This filament becomes red hot when a strong current of electricity is transmitted through the wires, and thereby lights the gas. One or two other expedients have been adopted, but hitherto with very partial success. But, although the simultaneous ignition of a number of jets cannot be effected with certainty, it seems far from improbable that the ubiquitous lucifer will be superseded by very simple and elegant arrangements. At a recent meeting of the Franklin Institute, Philadelphia, Messrs. Cornelius & Baker exhibited a very beautiful method of lighting gas by means of frictional electricity, arranged for use with a bracket, two portable lighters, and a table light, all being simple in arrangement and readily kept in order. These instruments are constructed upon the principle of the electrophorus. The electric bracket is arranged with a brass cup in the form of a vase, resting upon the bracket, with a connecting piece of hard rubber. This cup is lined with lamb-skin covered with silk, and contains the hard rubber electric piece which corresponds in form to the inside of the cup. A coiled covered wire connects the brass cup with a wire attached to the burner, and terminating just above the burner. In order to light the gas the stop is turned, the hard rubber piece lifted partly from the cup, thus liberating the spark and lighting the gas. The Portable Lighter consists of the same vase or cup, with the addition of a non-conducting handle. When the brass cup is lifted from the electric piece and held to the conducting wire of the burner, the gas is immediately lighted. Another portable instrument, called the Double Air-tight Electrophorus, consists of two metallic tubes, each closed at one end, and connected together at the other, with a non-conducting ring of hard rubber, the inside being lined with lamb-skin. A hard rubber rod is placed within them the length of one of the tubes, and fitting them so as to move somewhat freely from end to end. When the moveable piece inside is allowed to fall to one end, and the tube is raised to the connecting wire of the burner, this piece changes its place again, falling into the tube held by the hand. The spark leaves the upper end of the tube at the same time and lights the gas. The Table Light Burner consists of the same instrument arranged upon a pivot regularly attached to the pillar light. The subject is worth the attention of gas engineers here, and we feel little doubt that simple, inexpensive, and elegant little instruments of the kind we have described would soon become popular among us.—*Building News.*

THE ELECTRIC LIGHT AND PHOTOGRAPHY.

ABOUT three years ago, Dove received from Mr. Gunther, of Berlin, a photograph of a bronze statue of an amazon holding a lance in a perpendicular position, Mr. G. at the same time calling his attention to a singular mark in the picture, which was not in the original. The lance was properly delineated on the negative plate, but in addition, just at its tip, a dark streak was visible, though nothing of the kind had been observed at the time of taking the picture. Careful examination of the plate showed two other analogous marks. Dove thought that these singular appearances might have been caused by the presence of invisible electric brushes, resting on these points, and undertook some experiments to determine whether weak electric light could be photographed. Geisler tubes were used in a dark room, and, with the aid of Gunther, he succeeded in obtaining good photographs of the stratified discharge, as Professor William B. Rogers had done some months previously. This led Professor Rood, of Columbia College, to attempt the study of the electric brush by the aid of photography, but as its light is incomparably weaker than that from the Geisler tube, he found that no impression was produced on the sensitive

plate. Being unwilling to abandon the matter, a very sensitive collodion was then prepared from pyroxyline, in which the cotton fibre was somewhat disintegrated, and by its use good photographs were finally obtained of the positive as well as of the negative brush. An ordinary camera was employed, and the exposure lasted seven minutes. The minute photographs were then enlarged as usual, and prints made from the enlarged negatives.

The positive electrical brush consists, as is well-known, of a short stem, with widely-branching ramifications; these latter are very faint, even in the darkest room, and failed to produce an impression on the plate. The stem of the brush, which is somewhat more luminous, delineated itself very satisfactorily. It is well known that the negative brush is much smaller than the positive, and it is often spoken of as a star or minute point of light; the photograph, however, shows that this is not the case, but that its structure is analogous to that of the positive brush, only that the ramification begins lower down on the stem, as it were, nearly at its root.

Action of weak electric light on the plate in the presence of daylight.—The Geisler tubes, in the physical cabinet of the college, enabled Professor Rood now to put the probability of Dove's suggestion to the test of experiment; some of these were connected with an induction coil, and photographed in broad daylight, when it was found that the image formed by the electric discharge could be easily traced through the length of the tubes, and that even the stratification was still partially visible. In these cases, however, the electric light was still visible to the eye during the discharges.

Accordingly, to make an exact experiment on this point, a sheet of white paper was placed behind one of these tubes, and white daylight reflected through it towards the camera. The intensity of this reflected light was so regulated that the bright envelope of the platinum wire was nearly invisible, and the diffused violet light, at a greater distance from the wire, absolutely invisible. Nevertheless, an intense photographic image of the envelope, and a very distinct image of the diffused electric light, was easily obtained, thus proving conclusively the correctness of Dove's assumption, that electric light, which in ordinary daylight could not be seen, owing to its feeble illuminating power, might yet make itself very evident on the iodized plate, by virtue of its high per-centage of chemical rays.

This experiment is indeed a very striking proof of the chemical activity of the electric light, the more so as, according to some experiments, the iodized plate is by no means as sensitive to slight differences in illumination as the human eye.

Among the Geisler tubes belonging to the college was found one in which bulbs of uranium glass were alternated with small tubes of plain colourless glass. When the room was darkened, and the electric discharge passed through it, owing to their fluorescence the balls shone very brightly, invisible or faintly visible light being converted into bright green light. On taking a photograph of the tube, it was quite surprising to see how blank were the spaces on the plate, where the images of the green bulbs had fallen. After an exposure of four minutes only one of the bulbs could be faintly traced, though other portions of the discharge were represented by an intense deposit of silver. This shows how completely the electric light is divested of its chemical power by dispersion from a thin stratum of this kind of glass. It might be supposed that uranium glass would cut off most of the chemical rays when ordinary daylight was transmitted through it, but this was not found to be the case. The Geisler tube with the uranium bulbs was placed so that the light from a bright sky fell directly through it on the lens of the camera; the entire aperture of the lens (a "portrait combination" of six inches focal length) was used, and the exposure lasted one minute. An examination of the negative plate showed that the thin walls of the uranium bulbs had merely diminished to some extent, the chemical power of the rays passing through them. The same experiment with a plate of uranium glass, two-tenths of an inch in thickness, gave a result like in kind, only differing in degree, the chemical intensity of the light being diminished about one-half. This shows, in accordance with theory, that it is mainly the *dispersed* light which has lost its chemical power, and that through a plate of even this thickness many chemical rays still penetrate. A photograph of another Geisler tube, in which the interior discharge tube was surrounded by a solution of sulphate of quinine, was also taken. This liquid, by its fluorescent property, diminished, of course, the intensity of chemical action of the electric light, but by no means to the same extent as the uranium glass.

ON THE PATENT LAWS.

Discussion.

(*Continued from page 237.*)

Mr. Newton Wilson, who said it had been a matter of some surprise that the principle of the patent law should, at this stage of our national history, be called in question, while it was a thing which had been admitted by, he might say, every civilised nation in the world, and by almost every semi-civilised nation, as a necessity of advancing civilisation. He took it that, as a nation advanced in civilisation and in arts, the necessity of giving some encouragement and some protection to the products of inventive genius was absolutely necessary. In what they might call semi-civilised nations, such as Brazil, Chili, and Mexico, patents were given without any Government duty whatever; and why? because they found it necessary to give assistance to enterprise and encouragement to the introduction of new invention in those countries. Gentlemen who objected to the patent law on principle might, with equal justice, object to the legislation recently adopted for the security of trade marks. On the same principle, he could imagine objections to the law of copyright and the registration of designs. He believed that nine-tenths of the members of this Society, if not ninety-nine hundredths of the manufacturing community, would endorse the principle of the patent law, though perhaps they would say it was objectionable in many of its details. There were unquestionably many anomalies in connection with that law. We demanded from the poor inventor a larger sum than was called for in any other part of the globe for what was called the protection of his primitive efforts. If it paid France or Belgium to take a small annual payment, in the one case of £4 a year, and in the other of only ten francs, surely it would be sufficient for the purposes of this country if a corresponding scale were adopted, and he thought it would be found desirable to adopt—not the scale they had now of instalments, which prevented so large a number of patents from reaching the maturity of the final specification and the Great Seal. He thought that system would have to be considerably modified. The payment of a single £5 ought to be quite sufficient to complete a patent, and to meet all the demands of the Government; and if an annual payment of a similar amount were adopted, he believed it would bring a larger amount of revenue than at present, while it would be exacting from the inventor a continuous payment for a continuous interest which he derived from his patent. A particular feature in Belgium was that the patent fees increased year by year on the principle that the patentee was deriving a yearly benefit from his property. He would refer to one or two anomalies in connection with patents. They had at present an arrangement by which it was presumed patents were examined, and it might be imagined that a patent which was not good would not be granted, seeing it had to pass through the hands of the Attorney or Solicitor-General, and fees had to be paid; but this practically afforded no actual check. A large amount of the fees paid by inventors went into the pockets of the Attorney and Solicitor-General, for such services as, he maintained, were totally inadequate. What, then, did they want? He maintained that they wanted a Board of Examiners, who should really examine into the invention and decide whether it was really new, and so avoid the granting of useless patents. They would also be able to tell whether the specification was sufficient. If that were done, we should be saved from much uncertainty and litigation. The next point was the mode of trying patent cases. It appeared to him that for this to be properly conducted with advantage to both sides, there must be a special tribunal. He would have no juries in this court, for it was one where special knowledge was required. There was another point. It would appear that the present patent laws were enacted with a special view to guard the public. It was said by a very able speaker at the last meeting—the Chairman of the Council—that the public were not considered in the provisions of the patent law. He (Mr. Wilson) maintained that they were far too much considered, and that the interest of the inventor was too much disregarded. He maintained that the patent law was so constructed that if an inventor made a mistake in his patent he had the utmost difficulty in correcting it. There was no provision for revising his patent. There was a provision of disclaimer, but that was at the option of the Attorney-General, and, as Mr. Webster knew perfectly well, the Attorney-General might refuse a disclaimer, and then where was the inventor? But the very provision of the disclaimer as it at present existed was defective. It provided that certain words might be struck out, but it allowed the insertion of nothing that would clear the patent of the mystery that previously surrounded it. Another point of importance was patents of importation. In many countries of Europe, and in some of South America, patents of importation were allowed, but the same privileges did not extend to them as were allowed to patents of absolute invention. Here, however, the rights were the same, and the importer might prevent the real inventor from afterwards obtaining protection for his own invention. He knew cases in which the grossest injustice had been inflicted on inventors in that way. He had even known instances in which the inventor had been obliged to purchase the patent back at an enormous cost. Such a state of things, he said, ought to be remedied. It was alleged, at the previous meeting, by Dr. Bachhoffner, that inventors often made it their business to obscure the specification, so as not to allow the real objects of the invention to be clearly shown. From his (Mr. Wilson's) experience this rather arose from the shortcomings of

the patent agents, and he thought that if they had such a court of examiners as had been suggested, it would lead to much greater care on the part of patent agents; and he thought that patent agents themselves should be bound to pass through some curriculum before they put themselves before the world in this capacity. One other point of importance was the necessity for a Patent Museum in this country. Why should we not have something like what they had in the States of America? He conceived the Society of Arts could not do better than to appoint a committee to confer as to the best means of introducing an improved patent law, the provisions of which should, far more than the present one, meet the wants of inventors, manufacturers, and the public.

Mr. Steere remarked that the word "patent" suggested many points for consideration; one was that every patentee was grievously oppressed by law proceedings, as was also the infringer. Now, what was the question to be tried between the parties? It was simply a mere matter of fact, which should be tried before a tribunal of experts, (say a committee of the Society of Arts), and the only parties examined should be the patentee and his workmen on the one side, and the alleged infringer and his workmen on the other. But, as it now stood, the lawyer intervened, and, putting aside matters of fact, argued upon matters of law. It was then often discovered, upon legal reasoning, that the specification was insufficient. So little value did he (Mr. Steere) attach to the specification, that he would abolish it altogether. The simple fact to be decided was, whether an invention was an infringement of a former patent, and to determine that question what consequence was it in what terms the invention was described? By some such plan as he suggested they would relieve both parties of the enormous expenses which attached to the present system of litigation. The case of "Young and Fernie" was a remarkable instance. He would offer another suggestion, which was, that the word "patent" should be dropped altogether, inasmuch as so long as it was retained they never would get rid of litigation. We would prefer that the term "licence" should be used. He contended that the present system of litigation of patent rights required to be placed upon a totally different footing.

Mr. Murdoch said it would take up too much time if he were to attempt to answer the arguments of those who opposed the patent system, or to unravel the intricacy of the statistics which they brought forward. He would, therefore, restrict himself to a few remarks respecting the means proposed for the remedying of evils attendant on that system. He entered upon the subject with diffidence, as he should have to call in question the policy and practicability of the course advocated in Mr. Webster's able paper, respecting the mode of granting letters patent. It was proposed to subject all applications for patents to a preliminary inquiry, made by a tribunal having power to refuse the patent in the case of want of novelty or merit in the invention to be protected.

Mr. Webster said he did not intend that the question of merit should be submitted to such a tribunal.

Mr. Murdoch continued: Now, it seemed to him that such a tribunal would, both in its principle and practical working, be in direct opposition to the spirit of patent law, the chief merit of our present system consisting in the fact of its being an equitable arrangement between the inventor and the public, by which the reward received by the former was in proportion, in some cases, to the benefit conferred by his invention; in all, to the commercial value which attached to any new means for supplying the wants or contributing to the luxuries of society. Further, if property in inventions was to be protected at all, it must be placed upon the same footing as other property, and be secured to its possessor without reference to its value. Every new invention, whether of great or small importance, was deserving of State protection, and the mode of conferring that protection by letters patent was the fairest both to the public and the inventor. If his invention were valuable, it was but right that he should enjoy the profits resulting from its use: these the law secured to him. If, on the other hand, his invention were of trifling value, the hardship (if any), suffered by others, in being forbidden to exercise it, was but small. But if the invention were useless, there were provisions of the law which would meet the case by rendering the patent void, although the patenting of even a useless invention was attended by this beneficial result, that it placed upon record that which had been done in a manufacture, so that that which had been a stumbling-block in the path of one inventor often became a stepping-stone by which subsequent inventors attained success. But if the expediency of making the proposed distinction between inventions were to be granted, he did not see how the principle could be carried into practice. Nine out of ten of the inventions which annually became the subject of patents, were necessarily in a state of infancy when the patents were applied for. This fact was recognised by the law. which granted an inventor provisional protection for six months, in order that he might make such trial of his invention as should satisfy him as to its value, and enable him to describe his invention in its most perfect form in his final specification. If, therefore, the utility of an invention were to be inquired into before the grant of protection, the inventor would be under the disadvantage of having to submit his invention for examination with all those imperfections which could only be removed by repeated experiments, and it would be judged of theoretically instead of upon its practical merits. The examiners, also, however capable and impartial they might be, would, owing to deficiency of evidence, find it difficult to do justice to the cases submitted to them. They would have to try questions of far greater importance than those which were tried by our present tribunals, for, whereas these decided whether an asserted right should or should not be maintained, the examiners would have to decide whether a man should have the power of asserting his right at all, and in doing this they would be without the facilities which were now afforded in our courts of law by the examination of witnesses conversant both with the old methods of practising a manufacture and with the new method in dispute. Mr. Murdoch instanced the well-known case of Betts *v.* Menzies in illustration of this part of his argument. In this case it was contended that Betts's patent was bad because the invention it protected was described in the specification of a prior patent, and it was not till the case had gone from court to court that Betts's patent was decided to be good. Now, all this litigation arose from the similarity of Betts's and Dobbs's specifications, which was such, that if Betts, in order to obtain his patent, had been required to submit a description of his invention for preliminary examination, the patent would, in all probability, have been refused, on the ground that his invention had been anticipated by Dobbs; and although the practical difference between the two inventions was exactly that between success and failure, he would have been deprived of his reward. This was but one of many cases which might be cited, to show the injustice which would be inflicted upon inventors, and the loss which would be sustained by society, if the novelty or merit of an invention were to be investigated before the grant of the patent, although he was willing to admit that, in some cases, the difficulties which he had suggested would be met by the plan proposed by Mr. Wilson, which he took to be this—that the usual provisional protection (six months) should be issued, but that the novelty and utility of the invention should be inquired into previously to the sealing of the patent. There were cases, however, in which years elapsed before the invention was brought into satisfactory operation, and to such cases Mr. Wilson's proposition would not apply. It had been said that the action of the preliminary tribunal would be analogous to that of the Privy Council in prolongation cases. There would, however, be this difference—the examiners would have to decide on such evidence as might be collected during a period of a few months, whereas the Privy Council based its decisions on evidence that had been accumulating during the whole term of a patent. He did not think, however, that we need trouble ourselves to devise any system of preliminary examination, as the part of our patent system requiring reform was, not the mode of granting patents, but the mode of trying patent cases. The trial of a patent case was now so tedious, so expensive, and so uncertain, that men would often suffer wrong rather than go to law to obtain redress. The consequence of this state of things was, that inventors often took out patents without making due inquiry respecting the novelty of their inventions, and filed vague specifications, relying on the reluctance of others to contest their claims in a court of law, whilst, on the other hand, patents were often infringed by manufacturers and others, who hoped to wear out the patentees by the help of a long purse. In both cases capital became but too frequently a means of oppression. There were provisions of the present law which, if they could be readily and effectively administered, would be amply sufficient to meet such cases. There were remedies of the patentee against the public, and *vice versa*. The difficulty was that in applying these remedies the whole case turned upon the construction of the specification, which was a duty to which our courts, as at present constituted, seemed to be unequal. The remedy was to be found in the strengthening of the court, as set forth in Mr. Webster's second proposition, viz., "That the validity and infringement of patents should be tried by a judge, assisted by two or more assessors, conversant with the subject." He thought it would be very advantageous to extend the functions of this court to the granting and extension of patents. The court would then perform the duties which were now performed by the law officers, our courts of law, and the Privy Council. The advantages of this arrangement would be that those who examined applications for patents would not go out of office with each change of ministry, by which system their experience in matters of patent practice was at present lost to the public, and the court would be fully acquainted with the history of each patent granted.

Mr. G. W. Hastings had listened with interest to the opinions that had been advanced on this subject by practical men who had taken part in the discussion. He confessed, as far as he was personally concerned, he had no other pretension to speak upon the matter beyond that of strict impartiality. He had no personal interest in it whatever, and he simply represented the interest which after all would have to finally settle this great question—that was the interest of the public. He thought it rather unfortunate that one or two of the speakers had, probably in the heat of argument, thrown some doubt on the right of the public to have any interest in the question. Now he had every respect for the interests of patentees, but he thought the public had a right to be heard in the matter. It seemed to have been assumed by the gentleman (Mr. Spencer) who on the last occasion spoke in reply to the very admirable speech of Mr. Hawes, that if they once conceded that there was a property in invention, they at once settled the whole question, and that therefore the present patent law was always to be maintained. He begged to deny in the most explicit manner the force of that argument. He was fully impressed with the feeling that there was a property in invention, and that that property ought to be maintained. He thought when a great inventor gave to this country the benefit of some discovery, he was deserving of very high reward, and his merits ought to be recognised; but he did not see, while acknowledging that, that there

was any necessity to maintain the present or any patent law at all. Let them go for a moment into this question. The gentleman who opened the discussion this evening told them that the patent law and the copyright law stood on precisely the same grounds. Now, he (Mr. Hastings) could hardly imagine two things more diverse, and it was from that misapprehension partly that so many errors had crept into the subject. He would give them an instance of the difference between copyright and patent law. When Sir Walter Scott wrote his "Waverley," he introduced into this country an entirely new species of literature—historical romance—and he obtained the copyright of that work, and it would have been piracy to have reprinted it *ipsissimis verbis*; but they did not by that grant to Sir Walter Scott a monopoly in the printing of historical romances. They did not say that for a certain number of years he should be the only person in this country to produce novels of that description. They allowed any one who chose to write historical romances; but the principle of the patent law was that they should confer upon one man who had invented a particular thing an absolute monopoly in it. The point he arrived at was this: granting there was a property in invention, was the present system of patent law the best system for securing that property either as regarded the inventor or the public? He would deal with the question first as regarded the public. In ancient times it was considered that if an enterprising navigator discovered a new country, the only proper way to reward him was to make him a grant of that country; but in process of time it was discovered that the better plan of reward was to give a suitable recognition of the discovery, and throw the land open to public use and occupation. Much the same question was involved in the patent law—whether there was not a better way of rewarding than giving a monopoly? The argument on public grounds had been that by granting patents they encouraged invention. But what did one speaker say? That under any circumstances they would have invention—that invention, once in the head, it must come out. He quite subscribed to that. He believed the faculty of invention was like the faculty of poetry, or of art, and if a man had that genius within him he was sure to invent. If that were true, as the gentlemen in favour of the patent law had informed them, it seemed that the case of the patent law, as far as the public was concerned, fell to the ground; for it was clear the public had the benefit of the invention whether they rewarded the inventor or not. In that case every shilling paid in fees to the patent office was so much useless burden upon the public, for, after all, it came out of the public purse. It seemed to him, as far as the public was concerned, the patent law, on its present footing, was wholly indefensible. He would now consider the question from the inventors' point of view. Was the granting of a monopoly the best means of rewarding him? If there was any truth in the facts and figures of Mr. Hawes, it seemed a bad way of rewarding him. It seemed to create a lottery in which very often the best man lost and the worst man won. It seemed a mode of rewarding which might not only fail in its object, but might lead the unfortunate inventor to spend his whole life in an idle pursuit of riches. He thought, as far as the inventor was concerned, a more satisfactory plan would be that each invention should be valued by a competent tribunal, and that it should be rewarded by a certain sum at once from a public fund, upon its being declared to be a true and really good invention. That would surely be a more certain and, he apprehended, a more satisfactory plan than the present system of patents, and he thought this the more because he could not help feeling how inadequate had often been the rewards to really great inventors of this country under the present law. Large fortunes had often been made by men whom it would be ridiculous to term inventors—men who had made some trifling modifications, while those who had conferred illimitable advantages not only on this country but on the world, had sometimes been left to die in poverty. He trusted he had demonstrated first, that the present system was not satisfactory to the public, and secondly, that it was not so to inventors. If that were the case, he thought the legislature of this country, enlightened by the assistance of this Society, should take the matter into consideration, and enact for the benefit of inventors, as well as the community, a system which would be satisfactory to both, which would give the best reward to genius, and would not deprive the public at large of the free use of the invention.

(To be continued.)

CORRESPONDENCE.

THE BONELLI TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Your correspondent, — — - - —, forgot to mention in his letter that the only interruption in the working of the wires of the above company was owing to an accident to the aerial cable across the Mersey at Runcorn, the injury being caused by the mast of a ship.

Yours, &c., A FACT.

COLONIAL TELEGRAPHY.

THE following particulars of the telegraph in Victoria, is supplied by the *Weekly British Colonist*:—

The Act empowering the California State Telegraph Company to lay down a line of telegraph wires into this colony, which has now become law, is likely to work changes in our city in many respects. In the first place, it must of necessity work a revolution in mercantile affairs. There is not one of our Wharf-street merchants and not one of our Fort-street retail storekeepers but will feel the difference which telegraphic communication will make in their business. There are some who still hold to the exploded slow-coach system, and imagine that nothing can be done better because it is done more quickly than of yore, but in a city so dependent upon trade alone as is Victoria, the benefit of having immediate intelligence of the state of the markets in San Francisco and the Eastern States, and of our merchants being enabled to execute orders promptly from California markets, will rapidly make itself felt amongst us. To newsmongers the assistance of the wire will doubtless be very great, although it will rob our news of that interest which it has on the arrival of the mails by partially anticipating the items; but nevertheless we would fain hope that it will in some measure enliven us and render the contents of the columns of the daily journals more acceptable to our readers than at present. It is probably owing to a dearth of real news that some are occasionally betrayed into the grave error of abusing one another, and running down the prospects of the colony and city, which it is, unquestionably, our great interest to uphold.

The following are the provisions for the regulation of the telegraphic business of the colony.

Section 1, providing that employés or others may not divulge contents of messages nor alter the meaning of the same under a penalty not exceeding $1,000, or imprisonment for one year, was passed.

Section 2, providing that no forged messages be sent under a penalty not exceeding $1,000, or imprisonment for one year, was passed.

Section 3, providing that no employé shall appropriate any information under a penalty of $1,000, or one years' imprisonment, was passed.

Section 4, providing that no employé shall neglect to send messages under a penalty of $500, or six months' imprisonment, was passed.

Section 5, providing that unauthorized persons may not violate sealed messages, under a penalty of $1,000, or one year's imprisonment, was passed.

Section 6, providing that persons not employés may not fraudulently obtain any telegraphic information, under a penalty of $1,000, or one year's imprisonment, was passed.

Section 7, providing that no person may attempt to procure information by bribery, under a penalty of $1,000, or one year's imprisonment, was passed.

Section 8, providing that if any person shall wilfully obstruct or injure any telegraph lines or submarine cable, they shall be liable to a penalty of $500, or six months' imprisonment, was passed.

Section 9, providing for civil action for damages, was passed.

Section 10, exempting employés from militia and jury duty, was passed.

Section 11, providing that contracts made by telegraph shall be deemed contracts by writing, was passed.

Section 12, providing that notices served by telegraph may be deemed actual notices, was passed.

Section 13, providing that grants and conveyances may be made by telegraph, was struck out.

Section 14, providing that checks, due bills, promissory notes, bills of exchange, &c., may be made by telegraph, was passed.

Section 15, providing that certified instruments may be sent by telegraph, and shall *prima facie* be deemed genuine, was struck out.

Section 16, providing that arrests may be made by telegraph, was passed.

Section 17, providing that notes or orders may be sent by telegraph, was passed.

Section 18, providing that in any document sent by telegraph bearing a seal, the seal may be expressed by the letters "L. S.," or the word "seal," was passed.

Section 19, providing that any device adopted by the company may be made copyright, was passed; any person unlawfully using the same being liable to a penalty of $500, or six months' imprisonment.

Section 20, defining the construction of certain terms in the bill, was struck out.

Section 21, providing that telegraphic messages must be sent in order as received, under a penalty of $500, provided that official despatches, or those of a public or general interest, shall be transmitted out of their order, was passed

Section 22, conferring jurisdiction on justices of the peace to try any misdemeanour created under this act was passed.

The committee rose and reported the passage of the bill.

TELEGRAPHIC NEWS.

The Electric and International Dramatic Club.—The fifth entertainment of the above Society will be given at the Cabinet Theatre, Liverpool-street, King's-cross, on Thursday the 26th inst. The programme includes a comic drama, in two acts, by Messrs. Thos. and J. W. Morton, entitled, "All that Glitters is not Gold;" a domestic drama, in two acts, by Edward Fitzball, Esq., entitled, "The Momentous Question;" and other diversities.

Canadian Telegraph Company.—A new company has been organised in Canada, called the Provincial Telegraph Company, with which the United States Company will be connected at Suspension Bridge and Montreal. One of the most important features of this enterprise is its probable connection with a line to Europe, to which the attention of the public has not been called. This line is from the coast of Labrador, viâ Greenland, Iceland, and the Faroe Isles, to the north shore of Scotland. The longest distance from shore to shore is less than 500 miles—a less distance than cables are now successfully working in the Mediterranean.

Persian Gulf Telegraph.—The following telegram has been received from Col. Stewart, dated 30th March:—"Copper wire of cable parted about 90 miles from Fas at noon yesterday. This can certainly be made good in a few days. In meantime cable will be landed at Fas, and connection completed. Land line completed from Fas, 100 miles north of Kurnah; and from Bagdad 100 miles south; intermediate portion, 170 miles in length, passes through a country of Montific Arabs, at present in rebellion against the Turkish Government. Good reason to believe that differences will be immediately adjusted, and work recommenced; but for the present no certain means of communication with Bagdad except by river steamer."

A New Project.—The Floating Telegraph Station and Light-Ship Company has been announced, with a capital of £250,000, in shares of £10 each. The object is to provide and anchor ships near the ordinary track of vessels, in order to serve as electric telegraph and signal stations in communication with existing systems in Europe and America, and also as safety beacons for navigation. The first stations selected by this company for regular service are off the Scilly Islands, at the entrance of the English and Irish Channels, and off Cape Race, Newfoundland. The engineers and electricians to this company are Messrs. Forde and Fleeming Jenkin; and the board includes the names of several gentlemen well known in the commercial world.

MISCELLANEA.

Matter and Vacuum.—A pure vacuum is space void of all matter. Were all matter out of the universe, nature would then be nothing but a pure vacuum, and this pure vacuum would have some kind of an aspect. This aspect would be something similar in quality to the zigzag light which is formed when concentrated electricity suddenly divides the air, as when it lightens. Could a certain amount of space be freed of all matter, say a cubic mile, the freed space would have an appearance similar to the vacuum caused by concentrated electricity dividing the air, as when it lightens.

Process for Bleaching Gutta-Percha.—The *Journal de Pharmacie* gives the following process for bleaching gutta-percha:—"Dissolve the gutta-percha in twenty times its weight of boiling benzole, add to the solution plaster of very good quality, and agitate the mixture from time to time. By reposing for two days the plaster is deposited, and carries down with it all the impurities of the gutta-percha, insoluble in benzole. The clear liquid, decanted, is introduced by small portions at a time into twice its volume of alcohol, 90 per cent., agitating continually. During this operation the gutta-percha is precipitated in the state of a pasty mass, perfectly white. The dessication of the gutta-percha, thus purified, requires several weeks' exposure to the air, but may be accelerated by trituration in a mortar, which liberates moisture which it tends to retain."

Residual Magnetism.—Dr. A. Van Waltenhofen asserts that the amount of magnetism remaining in the soft iron of an electro-magnet, after the cessation of the electric current, is dependent on the manner in which the current is interrupted. The amount is greater after a gradual interruption. The residual magnetism in very soft iron is often of an opposite nature to that previously existing, after the very sudden interruption of a strong current. This seems to him to furnish strong proof that magnetism is not caused by the separation of two fluids, but by the motion of magnetic molecules to which is opposed a certain amount of frictional resistance. He compared each magnetic molecule to a spring which is bent back. If suddenly released it will return to its original position or go beyond it, but if gradual released it will not go quite to its primitive place.

Pure Copper Paint.—A new pigment, calculated at the same time to increase the resources of the decorative painter, and to afford a ready means of preserving iron and other metals, has recently been introduced at Paris by M. L. Oudry, of the Auteuil Electro-Metallurgic Works. He first obtains a pure copper by throwing down the metal by the galvanic process; he then reduces the precipitate to an impalpable powder by stamping. This powder is then combined with a particular preparation of benzine, and used in the same way as ordinary paint; beautiful bronzed effects are produced upon it by means of dressing with acidified solutions and pure copper powder. The articles painted with the new material have all the appearance of electro-bronze, whilst its cost is less than one-sixth; it will last from eight to ten years. Mr. Oudry also proposes to substitute benzine oil for linseed and other oils, over which he states it possesses great advantages.

Coast Signals.—Some public-spirited individual writes the appended letter to the Stoughton (Mass.) *Sentinel*. Apparatus similar to that mentioned by the writer alluded to is now in use; but he advances some original ideas which are worthy of attention:—"Having been impressed with the idea that some kind of a trumpet or whistle might be made that would be very useful to give warning to seamen when located on dangerous rocks and shoals, to ease my mind I have concluded to give some of my ideas for you to dispose of as you may think proper. The trumpet for this purpose should be like the common ones, except in size, with a shell attached to the mouth-piece like a small egg-shell, with a whistle or reeds, as scientific men versed in such instruments may determine, with another larger shell over it, with space between sufficient to blow through. I should think when blown this would be a sufficient warning in fogs. Not knowing what sounds are produced by the wind, rigging, and waves, I suggest none, for I never heard them. Some of the methods of blowing are by a pipe (the right length and dimensions of which would depend on the size of the boat to which it was attached), to rise and fall perpendicularly in the water with the motion of the boat, with a tube leading from the pipe to a trumpet. Any one wishing may see the principle on which it works by taking a keg, knocking out one head, bore a hole in the other, and passing it up and down perpendicularly in the water. Another way may be possible by a ball fitted inside of a tube to roll back and forth by the motion of the boat, with valves inhaling and exhaling, as the case may be, and tubes leading to the trumpet. Possibly weights might be suspended so as to swing and blow a bellows, or perhaps weights to run on a trundle to be passed back and forth by the motion of the boat, with a rod entering one end of a tube and a piston on the end to pass back and forth in the room of a ball; or perhaps the waves, in passing a boat, might turn side wheels and blow a bellows. May not such a one be sufficient for calms, and cannot one be blown in storms by wind? and may not the sound be increased by the bigness of the trumpet and the number of whistles blown in it? Now, cannot some of your readers study out and put in operation an invention of this character which will be of so much value to seafaring men?"

Diseases of Overworked Men.—Time was when the very phrase, diseases of overworked men, would have been considered foolish, and out of the question; now it conveys a truth of national importance, which the nation must consider. From being a comparatively idle world, we have, of late, become an insane world on the subject of labour. So long as the muscles merely were employed, so long little harm was done; we remained men; now we aspire to be gods, and we pay the forfeit of our ambition. From overwork we now get a class of diseases the most prolonged, the most fatal. The suns of our best men go down at noon, and so accustomed are we to the phenomenon that we cease to regard it as either strange, or out of place. It is through the mind now that the body is destroyed by overwork; at all events, it is so mainly. The men of intense thought—men of letters, men of business who think and speculate, men of the state who are ambitious to rule, these men are sacrifices. With them the brain has not merely to act on its own muscles, bidding them perform their necessary duties, but the one brain must needs guide a hundred other brains, and all the muscles thereto appended. An electric battery works a single wire from the City to Brighton, and does its work well, and goes on for some months before it is dead or worn out. Can it do the work of a hundred wires? Oh yes, it can, but it must have more acid, must wear faster, and will ultimately die sooner. We may protect the plates, make the battery, to an extent, self-regenerative as the body is, but, in the main, the waste is in excess of the supply, and the wear is as certain as the day. Men of letters, men of business who do their business through other hands and do great business, and men immersed in politics, suffer much the same kind of effects from overwork. They induce in themselves, usually, when they suffer from this cause, one or other of the following maladies:—Cardiac melancholy, or broken heart; dyspepsia, accompanied with great loss of phosphorus from the body; diabetes, consumption, paralysis, local and general; apoplexy, insanity, premature old age. They also suffer more than other men from the effects of ordinary disorders. They bear pain indifferently, can tolerate no lowering measures, are left long prostrated by simple depressing maladies, and acquire, in some instances, a morbid sensibility which is reflected in every direction; so that briskness of action becomes irritability, and quiet, seclusion and moroseness. They dislike themselves, and feel that they must be disliked, and if they attempt to be joyous, they lapse into shame at having dissembled, and fall again into gloom.—*Social Science Review*.

THUNDER-STORMS.—Storms of thunder and lightning are simply a case of electrical discharges from one cloud to another, and are a means adopted by nature to restore electrical equilibrium in the atmosphere, and at the same time clear the air from unwholesome vapours or properties. The explanation of thunder-storms given by Professor Thomson, in his "Outlines of the Science of Heat and Electricity," being the best we have seen, we shall lay it before the readers:—"Air and all gases are non-conductors; but vapour and clouds, which are composed of it, are conductors. Clouds consist of a kind of bladders of vapour, charged each with the same kind of electricity. It is this electric charge which prevents the vesicles from uniting together, and falling down in the form of rain. Even the vesicular form which the vapour assumes is probably owing to the particles being charged with electricity. The mutual repulsion of the electric particles may be considered as sufficient (since they are prevented from leaving the vesicle by the action of the surrounding air and of the surrounding vesicles) to give the vapour the vesicular form. In what way these clouds come to be charged with electricity, it is not easy to say. But, as electricity is evolved during the act of evaporation, the probability is that clouds are always charged with electricity, and that they owe their existence, or at least their form, to that fluid. It is very probable that when two currents of dry air are moving different ways, the friction of the two surfaces may evolve electricity. Should these currents be of different temperatures, a portion of the vapour which they always contain will be deposited; the electricity evolved will be taken up by that vapour, and will cause it to assume the vesicular state, constituting a cloud. Thus we can see, in general, how clouds come to be formed, and how they contain electricity. This electricity may be either vitreous or resinous, according to circumstances. And it is conceivable that, by long-continued opposite currents of air, the charge accumulated in a cloud may be considerable. Now, when two clouds, charged, the one with vitreous and the other with resinous electricity, happen to approach within a certain distance, the thickness of the coating of electricity increases on the two sides of the clouds which are nearest each other. This accumulation of thickness soon becomes so great as to overcome the pressure of the atmosphere, and a discharge takes place which occasions the flash of lightning. The noise accompanying the discharge constitutes the thunder-clap, the long continuance of which partly depends on the reverberations from neighbouring objects. It is, therefore, loudest and largest, and most tremendous in hilly countries. These electrical discharges obviously dissipate the electricity; the cloud condenses into water, and occasions the sudden and heavy rain which always terminates a thunder-storm. The previous motions of the clouds, which act like electrometers, indicate the electrical state of different parts of the atmosphere. Thunder, then, only takes place when the different strata of air are in different electrical states. The clouds interposed between these strata are also electrical, and owe their vesicular nature to that electricity. They are also conductors. Hence they interpose themselves between strata in different states, and arrange themselves in such a manner as to occasion the mutual discharge of the strata in opposite states. The equilibrium is restored; the clouds, deprived of their electricity, collapse into rain, and the thunder terminates. In thunder-storms the discharges usually take place between two strata of air, very seldom between the air and the earth. But that they are sometimes also between clouds and the earth cannot be doubted. These discharges sometimes take place without any noise. In that case, the flashes are very bright; but they are single flashes, passing visibly from one cloud to another, and confined usually to a single quarter of the heavens. When they are accompanied by the noise which we call *thunder*, a number of simultaneous flashes of different colours, and constituting an interrupted zigzag line, may generally be observed stretching to an extent of several miles. These seem to be occasioned by a number of successive or almost simultaneous discharges from one cloud to another, these intermediate clouds serving as intermediate conductors, or stepping-stones, for the electrical fluid. It is these simultaneous discharges which occasion the rattling noise which we call thunder. Though they are all made at the same time, yet, as their distances are different, they only reach our ear in succession, and thus occasion the lengthened rumbling noise, so different from the snap which accompanies the discharge of a Leyden jar. If the electricity were confined to the clouds, a single discharge, or a single flash of lightning would restore the equilibrium. The cloud would collapse and discharge itself in rain, and the serenity of the heavens would be restored; but this is seldom the case. I have witnessed the most vivid discharges of lightning from one cloud to another, which enlightened the whole horizon, continue for several hours, and amounting to a very considerable number, not fewer certainly than fifty, and terminating at last in a violent thunder-storm. We see that these discharges, though the quantity of electricity must have been immense, did not restore the equilibrium. It is obvious from this that not only the clouds, but the strata of air themselves, must have been strongly charged with electricity. The clouds, being conductors, served the purpose of discharging the electricity with which they were loaded, when they came within the striking distance. But the electric stratum of air with which the cloud was in contact, being a non-conductor, would not lose its electricity by the discharge of the cloud. It would immediately supply the cloud with which it was in contact with a new charge. And this repeated charging and discharging process would continue to go on till the different strata of excited air were brought to their natural state."—*Chambers.*

PATENTS.

LETTERS PATENT.

2893. J. G. Jennings, and M. L. J. Lavater, improvements in the manufacture of tubes, rings, and cords of india-rubber, and in covering telegraph wires.

2962. C. L. Daboll, improvements in fog-signals or alarums.

PROVISIONAL PATENT.

999. H. H. Bonneville, a new method of obtaining a semi-fluid or solid product obtained by concentrating the saponaceous parts of the qualli tree.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good	2/2 to 2/6	per lb.
Good re-boiled	1/6 to 1/8	„

INDIA RUBBER.

Para, first quality	1/10 to 1/11	„
second „	1/7 to 1/8	„
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Java and Penang	1/4 to 1/5	„

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	99 to 102	—
100	Submarine Telegraph, scrip. .	all	48 to 53	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street, E.C.; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before SEVEN O'CLOCK on Thursday evening in each week. The charges for Advertisements are—

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THE TELEGRAPHIC JOURNAL.

VOL. I. No. 22.—MAY 28, 1864.

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THE CONSTRUCTION OF TELEGRAPHS.

(*Continued from page* 242.)

At every terminal station especially a very important matter is the "earth." This should receive the most strict attention. Too much care cannot be taken to secure a good one. The method usually adopted to test an earth-wire is to send a current in one wire, placing a sensitive galvanometer in circuit on the shortest of the others—one erected on separate poles, if possible. If no current passes through the galvanometer the earth is perfect. A bad earth will not only increase the resistance of a circuit, rendering the signals weak, but where more than one wire is in connection with it, will form a contact; for it is evident that the charge being rejected by the earth wire, in consequence of the non-conductive powers of the soil, it will return and traverse that other wire affording it least resistance, till it has completed its circuit. A water or gas-pipe is preferable to an earth-plate from the larger surface it affords. Care must be taken to make the connection with the main street gas-pipe, as the joints of indoor gas-pipes are frequently packed with white or red lead. A case is recorded where an earth-wire, which was connected to a small leaden gas-pipe, in use at the time, when a strong flash of lightning passed along the wire, and, consequently, into the earth-wire. The connection was, probably, not a good one, for the pipe was melted at the point of contact, and the gas ignited, causing considerable danger to property. This is another objection to the use of indoor gas-pipes.

When neither water nor gas-pipes are obtainable, an earth may be formed as follows:—Select a spot, where by digging to a reasonable depth—say 6 or 8 feet—you may find soil wet at all seasons. Form a narrow trench, in which lay your earth-plate, composed of a strip of lead not less than 4 feet by 2. Do not coil it, but let it be buried flat and upright, rather than horizontal. To this connect your earth-wire, and fill in the trench with coke.

It sometimes happens that an *earth* cannot be found. This is frequently the case in chalky ground, or where the soil is constantly dry. The evil may, perhaps, be overcome by employing a separate earth-plate for each circuit, maintaining them at such a distance apart that the resistance of the soil, between the plates, shall be greater than the resistance of the earth to the diffusion of the tensions. If this fail, we have but one alternative, viz., to carry a wire along the poles till we come to a spot capable of affording a good earth.

Mr. Culley, in his "Handbook," previously referred to, quotes the following interesting results obtained by Matteuci; the size of the earth-plates being the same in each case:—

	Resistance.	Resistance.
Plates 1 yard apart on the level plain,	68, on a mountain,	152.
" 5 " "	97, "	—
" 10 " "	102, "	222.
" 20 " "	109, "	—
" 50 " "	123, "	531.
" 100 " "	—	809.

The resistance diminishes with the depth to which the plates are buried.

When buried 4 inches the resistance was	91.
" 10 " "	83.
" 40 " "	74.
" 80 " "	70.

The size of the plates has the greatest influence on the resistance.

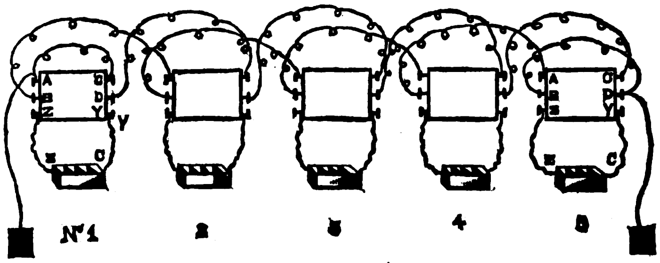
If a plate containing 1 square foot of surface gives a resistance of 174,

A plate of 4 square feet will give a resistance of	140.
" 16 " "	81.
" 25 " "	47.
" 32 " "	31.

But after a certain size, varying with the conductive power of the soil around the plates, the resistance remains constant.

It sometimes happens that very short circuits are troubled with a permanent, though perhaps not a very strong current, constantly deflecting the needle to one side. You may safely attribute this to the earth-plates. An iron earth-plate at one end, and a copper or lead one at the other, will form a battery, and emit the current observed. Thus the necessity of having both earths similar, or as nearly so as possible.

The following sketch will enable the student the more easily to follow up the various connections.



Having gone through the important question of "earth," we may now commence joining up our instruments. To our old and esteemed friend, the double-needle, we give the precedence. Each terminal is marked generally as shown in the figure. A, B, and Z, on the left hand side, C, D, and Y, on the right. A, B, C, and D, are the line terminals, Z and Y, battery terminals. A and B communicate with the + E needle, whilst C and D form a circuit with the H N. With the battery terminals we cannot well make a mistake, there are but two, both marked. Should they, however, not be marked, take a note, that zinc is connected to the left hand terminal, and copper to the right. With the other four terminals we shall be apt to err, unless we bear in mind which is the up and which the down, that through which the current enters the instrument, and that by which it leaves it. Method is the soul of success. Let it then be determined that A and C shall bear the up wires, and B and D the down wires. Unless we start with some such arrangement, we shall probably confuse our wires and connect our instruments up wrongly. If we cross the wires, that is connect the + E wire to B, instead of to A, and the down wire to A, the signals made by that instrument will appear correct, but will be reversed at all other stations. Signals sent by any other station will also be reversed to you. By altering the wires of the H N, we meet with a similar result. To change the battery wires would reverse all signals made by you, not only at your own station, but throughout the circuit. We here surmise that all the leading-in wires have been duly marked as they should be, at the time they are laid in, in accordance with the wires as they stand on the poles. The circuits are arranged as follows:—Nos. 1, 2, and 3, are devoted to the train signals; No. 4, to the printing circuit; Nos. 5 and 6, double-needle. The object in thus selecting them is, as will be inferred, that we may devote those wires least likely to meet with interruption to the most important circuits. The top wire will not, of course, be liable to so many interruptions from contact as the lower wires, for although every possible precaution is adopted, yet a wire will occasionally snap from a bad weld, or an insulator will give way, and many other accidents occur, unlooked for till they actually take place.

Selecting No. 5 line wire we connect it to the instrument at A; No. 6 to C; and B and D, having to be put to earth, we connect our earth to the latter, and, leading a wire thence, join it to B. Thus the current enters at A, passes through the + E coil, thence into the spring, and away through B, into the earth. With the H N, it follows a similar course, entering at C, and leaving by D.

We may now pass on to Nos. 4, 3, and 2 stations. Here the connections are all the same, except that instead of connecting up the earth to B and D, we join up the down line wires. Arrived at No. 1, we have but to repeat the care and attention bestowed upon No. 5, look to the earth, and connect up the batteries and line wires. Here we find the earth wires connected to A and C, B and D being occupied by the down wires.

FLOATING TELEGRAPH STATION AND LIGHT-SHIP COMPANY, LIMITED.

A very laudable project has been launched, and, we hear, rapidly approaches realization—if a kindly reception in the money market augurs any good. The objects proposed to be encompassed by the Floating Telegraph Station and Light-ship Company, Limited, commend themselves to the mercantile and marine interests of the country as of vital importance. Any scheme which is calculated to either protect our commerce, or expedite our communication with friendly countries, separated by vast oceans or solitary wildernesses, will never fail to receive support; for a nation that turns over in its trade the sum of £1,500,000 with every setting of the sun, or an amount equal to, if not exceeding, £547,000,000 sterling annually, needs every application of science and art to aid in the development of its illimitable resources. The genius of our inventors is readily met by the spirit of enterprise in our capitalists, and we have now to chronicle the application of an useful invention to one of the most important undertakings of the present age. The aforesaid company will provide and anchor ships near the ordinary track of vessels trading between Europe and America and elsewhere—said vessels to serve as telegraph and signal stations, and also as beacons for navigation. The method by which the company purpose to carry out its plans has not transpired, but we have reason to believe that it is in contemplation to purchase Moore's patent for an improved method of anchoring ships, and attaching electric cables. By this invention it is alleged that a vessel can be moored amid the wild waves of the Atlantic, and can secure easy communication with passing ships and with the shore. The stations selected for the first operations of the company are off the Scilly Islands, the entrance to the English and Irish Channels, and off Cape Race, Newfoundland. These positions recommend themselves as eligible depôts, for about 100,000 vessels pass Scilly and 3,500 pass Cape Race annually. Moreover, the frequent opportunity for performing salvage services, and the eagerness with which navigators seek to obtain these points of departure for entering the English and Irish Channels and the Gulf of St. Lawrence respectively, considerably enhance the importance of the project, which certainly promises to be exceedingly profitable.

This company's ships will be fitted up complete as telegraph stations. It is also intended to provide them with steam power and lanterns for displaying a powerful light. Day and night signals, steam whistles, guns, lifeboats, &c., will also form part of their equipment. Stores, water, and provisions will be kept on board for the immediate requirement of vessels in distress; a further supply, including coals, will be kept on shore, always available at a few hours' notice.

Steam-tenders, fitted up for the conveyance of passengers, mails, specie, and merchandise, and capable of acting as tugs, will be provided by the company, so that assistance can be rendered to disabled or derelict vessels.

At the station at the entrance of the English Channel all vessels arriving from India, China, North and South America, the Cape of Good Hope, West Indies, and all parts of the world, whether bound for England or the Continent, will exchange news and communicate arrival from one day to a week before reaching port; and those outward bound will receive news and instructions so much later. The advantage gained in point of time between Cape Race and New York will vary from *four days* for steamers to *a fortnight* for sailing vessels. The importance to trade of these facilities can hardly be estimated, but an idea may be formed of the profits likely to be realised, when it is stated that if but one vessel in three sent only a single message, the profits would, at £1 per message, pay nearly 15 per cent. upon the capital. It is expected that most ships will telegraph their numbers on arrival and departure, and that off Scilly a large number of those arriving will call for final orders of destination, whilst the English, Irish, and Bristol Channels are still open to them. It is understood that even now, when the uncertainty of delivery keeps the number of messages at a minimum, numerous telegrams for the United States and Canada are conveyed by each mail steamer, to be landed, if possible, at Cape Race. The steamers are only occasionally intercepted in fine clear weather by a sailing boat belonging to the Associated Press. The charge for landing is at the present time over £2 per message.

This project recommends itself, not only in its commercial aspect, but as tending to diminish the destruction of life and property, as it will enable vessels to ascertain their position by light-ships at sea, thus avoiding the necessity of a near approach to the shore, and enabling them to proceed on their course with confidence and safety.

The main source of revenue is expected to arise from telegrams, as the company's line will connect the Scilly Islands with the European telegraphic system. In addition, it is believed that the profits to be derived from salvage, the sale of stores, and the embarking and disembarking of mails, parcels, and passengers, will prove eminently remunerative, while the saving of human life from shipwreck off dangerous coasts is a consideration which will doubtless induce many to embark in this enterprise uninfluenced by the attractions of large returns for capital invested.

A SPECIAL LINE FOR URGENT MESSAGES.

Within the past few years many improvements have been effected in the administration of telegraph companies. The tariffs for the transmission of messages have been considerably reduced; additional stations have been opened wherever a prospective business could be anticipated, and the greatest facilities have been offered the public for communication by the telegraph. But there is still a deficiency in the system which might be provided against without material interference with existing arrangements. The practice of sending telegrams without distinction as to character, on the principle of "First come, first served," is fraught with many disadvantages which have been very forcibly pointed out by our contemporary, *The Realm*:—

"The invention which especially distinguishes the advanced science of the day, and which has introduced a new element into politics, and even war, is the electric telegraph. Telegraphic communications are at present carried on by private enterprise, and though Government can, and has, on great and critical occasions, monopolised them for a time, the companies alone are responsible for the orderly and accurate transmission of information, both public and private, demanding unusual dispatch. Important as are the public functions of telegraphic companies, they owe their origin to, and derive their chief support from, the public's private and personal requirements. The importance of these communications varies infinitely, from cases in which dispatch or delay means life or death, down to a telegram for a night-cap and tooth-brush. The

present rule, if rule there be, seems to be the transmission of messages in the order of their arrival at the office, irrespective of their relative importance—the price of strawberries and young potatoes in the Bath market, taking possible precedence of a summons to a death-bed, or the few words which would relieve agonies of anxiety and suspense.

"Government has not hesitated to interfere with private companies in the case of railways, forcing them to run a certain number of trains at a low rate of payment to benefit the poorer classes of society, whether remunerative to the companies or not; why should it not interfere so as to place the telegraphs under some systematic and efficient regulation? Our attention has been drawn to this subject, which involves a great evil, one demanding an immediate remedy, if the telegraph is to be in fact, that which it professes and is generally supposed to be, a means of instantaneous communication in cases of difficulty.

"Instances of failure in this respect will occur to too many of our readers. We will give an instance. In a recent case a message from the south of Europe requiring the immediate presence of a near relative, arrived at a country town in England in twelve hours —as rapidly, in fact, as could be expected. The terms of the message were urgent, 'start instantly.' A man was sent to *walk* the remaining eighteen miles, to bring it to its destination, and, in consequence, the first train and the first packet over the water were missed, the telegram itself being so mis-spelt as to make the route intended to be indicated, incomprehensible! Mere carelessness! In a copy of this telegram forwarded the next day, too late to be of use, the words were correctly spelt. What excuse can be offered for such slovenly work as this?

"Again, an urgent telegram most anxiously expected, arrived in London late on Saturday night. The office was closed. That message was detained till Monday morning. A message respecting a little dog, and another asking some children to a dance, were forwarded by a mounted messenger post-haste. Discretionary power is open to bribery; but these companies who are paying large dividends derived from the confidence of the country in the effectual performance of the functions they profess, should have some systematic classification by which urgency can be tested if only by the rough proportion of money to speed. Some provision might be made at exceptional rates for nights and Sundays. And the high-rate messages should be backed with some recoverable damages for neglect, so as to enforce the terms of special contract as to guaranteed dispatch. As it is, the companies shift responsibility from one line of wires to another, or decline responsibility altogether. But if they were bound by law to undertake and fulfil adequately-paid engagements, they would soon find means of settling terms of mutual arrangement by which the office where neglect or delay occurred should be mulcted duly.

"The public has a helpless sense of imbecile incapacity in the presence of those perky little magicians who manipulate and decipher the lightning with such autocratic unconcern. It might have a good moral effect if one of these worthies received a little penal castigation now and then. The pointsmen who neglect their switches on railways are liable to the law. And as lives may be lost by muddling a telegram for a surgeon as well as by turning a train on to the wrong line, an example now and then might be wholesome *pour encourager les autres*.'"

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 246.)

J. Gressler & Co., Berlin, H. M. (Prussia, 1,402), exhibit a regulator in which the electrodes are carried on two little cars, which run down inclined planes to meet one another. The electrodes are held parallel to these inclined planes, and move equally. The motion of the cars drags a long armature past the poles of an electro-magnet, and when the current is of the required strength, or greater than that strength, the armature adheres to the electro-magnet, and stops the cars. M. Gressler also exhibits an arrangement in which one electrode only moves, and is arrested by similar means when a given current passes round an electro-magnet. These arrangements are cheap, but have several obvious defects.

Murray & Heath, H. M. (United Kingdom, 2,937), exhibit a lamp in which the upper electrode is fixed, or rather adjustable by hand only; the lower electrode is self-adjusting. The current, in passing from one pole of the battery to the lower electrode, is divided into two branches, one of which contains the usual electro-magnet, working the detent which regulates the rise of the lower electrode, and the other contains a rheostat or variable resistance, by the adjustment of which the proportion of the current passing through the other branch round the electro-magnet can be altered. Thus, a large portion of a weak current, or a small portion of a strong current, can at will be used to work the electro-magnet. The distance between the armature and the electro-magnet can also be varied, and still further increases the range of adjustment. The position of the light alters as the carbons consume, and the light is not automatically relighted if accidentally extinguished. It is not, therefore, in its present form adapted for lighthouses or similar purposes, but no doubt will give excellent results in the lecture-room, or in experimental investigations.

F. H. Holmes, M. (United Kingdom, 1,886), uses with his magneto-electric machine a lamp of his own invention, which produces a very regular and constant light entirely free from flashes. This lamp is somewhat similar to Duboscq's in principle, but differs from it in many important practical details. The construction is very simple; two cords are wound in opposite directions round two portions of one shaft of unequal diameters. The cord from the larger portion of the axis is led down under a pulley on the frame, which carries the upper electrode, and then up to a lever, the functions of which will be described presently. The bight of the cord under the pulley supports the upper electrode with its frame. Similarly the cord from the smaller part of the axis is led down under a pulley on the frame carrying the lower electrode, and then up to a pin which can be turned round by hand so as slightly to lengthen or shorten the cord. The bight of the second cord supports the lower frame and electrode. The upper frame would, if unchecked, fall down, unrolling its cord from the larger portion of the shaft, but winding up the other cord on the smaller part of the shaft, and consequently raising the lower frame and electrode. The rise of one and the fall of the other take place in the proportion of the diameters of the two parts of the axis. This movement is checked by a detent, gearing into a star escapement-wheel. The armature of an electro-magnet, A, frees this wheel when the current falls below a given strength, depending on the adjustment of an antagonistic spring attached to the armature; a continuous feed is thus produced exactly similar to that obtained from Duboscq's lamp. The pin already mentioned, by shortening or lengthening the cord of the lower electrode, allows its height to be adjusted with ease and accuracy, so as to bring the light into the exact centre of a reflector or lens if necessary.

The lever to which the one end of the cord of the upper electrode is secured is so centred that, by slightly rocking, it lifts or lowers the one end of the cord, and consequently the whole frame or electrode; this motion is confined within small limits by stops. A weight on the other end of the rocking lever nearly balances the weight of the upper frame, and an armature attached to this weight hangs immediately over a second electro-magnet, B. When no current circulates through the lamp, the weight of the frame and electrode overbalances the counterpoise. The armature of B is lifted from the magnet, and the end of the lever, carrying the cord, falls, lowering the upper electrode, but when the current is passing, the armature of B is attracted, and with the aid of the counterpoise, pulls down one end of the rocking lever, lifting the cord, and consequently the upper electrode. The first-named electro-magnet, A, then works the detent, regulating the continuous feed. If the current fail for an instant—if, for instance, the light be blown out—the armature of the second magnet flies up, the upper electrode falls into contact with the lower, re-establishes the current, and again is at once drawn up to the original distance, so that the lamp is relighted.

If the interruption lasted more than a very short time this part of the action would fail, for the escapement-wheel is also freed by the cessation of the current, and the continuous feed would jam the two points together, or break the sticks of carbon. Thus, although this lamp relights itself if momentarily extinguished, it will not do so if extinguished for more than a very short time, and it cannot be lighted at a distance by simply turning on the current, or extinguished by interrupting the current. In order to extinguish the lamp it is necessary to lock both the rocking lever and the escapement-wheel; and to light it, it is necessary to free both of these parts.

Mr. Holmes' lamp, together with his magneto-electric machine, have, since the 2nd of June last, worked successfully at Dungeness lighthouse, exclusively in the hands and under the care of the Trinity House. By the kindness of the Brethren, the writer is

able to state that it has since that time been accidentally extinguished only four times, and then only for a moment, having been immediately attended to; the light was observed to quiver occasionally, and also to wax and wane; the circumstances which occasioned these changes being the varying presence of iron in the carbons, slight variations in the position of the carbons relatively to each other, and the presence during some months of an abundance of large moths in the lantern. These, it will be observed, are very slight defects, and Mr. Holmes has, moreover, informed the writer that the four momentary extinctions took place when the light was under the charge of a man who had had no previous instruction, and who had been sent temporarily to take the place of one of the regular attendants absent on leave. Mr. Holmes also doubts whether the other slight defects can be in any way attributed to his lamp; but whether this be so or not, it is evident that an electric lamp which, with no greater failures than these, can be left for months in the hands of the lighthouse attendants, without any supervision on the part of the inventor, must possess great excellence. Mr. Holmes uses a slightly different lamp for signals, or other purposes for which the light requires to be frequently extinguished and relighted.

V. Serrin, Paris, M. (France, 1,437), exhibits an electric lamp with a regulator possessing very remarkable qualities. This lamp is lighted by simply turning on the current, and again extinguished by interrupting the current; it can, therefore, be lighted and extinguished at a distance as often as may be desired. This could not be done by any other lamp exhibited except, perhaps, by that of Mr. Hart. The construction of the instrument is as follows:—The wheels regulating the approach of the two electrodes are driven by the predominant weight of the descending electrode with its frame, and the relative motion of the two electrodes is determined by gearing, in the ratio of their consumption, so as to keep the light in one position. The motion is stopped by a toothed wheel and detent, and this detent is released by the armature of an electro-magnet. So far the lamp does not differ essentially from those of Duboscq and others. The frame or tube carrying the lower electrode is capable of moving vertically to the extent of three or four millimetres, by being fixed on an articulated parallelogram, which oscillates on two centres.

This vertical movement is quite independent of the rise of the electrode produced by the gearing, which pushes the carbon up through the oscillating tube by means of a metallic chain; the greater or less tension of the chain, and the friction of the rod in the tube, in no way impede the freedom of oscillation of the parallelogram, owing to the peculiar arrangement of the chain, which is led horizontally from the fixed gearing to a pulley in the oscillating system. It passes round one quarter of this pulley, and is carried down the rod in which the lower electrode is fixed. The tension of the chain as arranged pulls up the rod and electrode through its gearing tube, and pulls the oscillating system horizontally against its bearings, but does not interfere with the freedom of motion. An armature of soft iron is fixed to the bottom of the parallelogram; this armature is a flat horizontal bar bent down at right angles at each end. The two vertical projections embrace the two poles of a straight electro-magnet at a distance of about two millimetres. The motion of this armature is in a plane perpendicular to the axis of the electro-magnet, the attraction of which tends to bring the centre of the two end flanges in a line with its own axis. The object of this disposition is to obtain considerable range without the very rapid variation of attraction which occurs when an armature moves to or from a magnet in the direction of its axis. An adjustable spiral spring lifts this armature and the oscillating system; the tension of this spring is adjusted so as nearly to balance the weight of the whole oscillating system. The detent, which stops or releases the wheelwork, is also attached to the parallelogram, but the escapement-wheel forms part of the fixed gearing. The rise of the parallelogram brings the carbon points a very little closer, and at the same time allows one or more teeth of the escapement-wheel to pass, so that the wheelwork revolves, and the carbon points are both moved forward a little; the descent of the parallelogram stops the wheelwork, and separates a very little the carbon points. The rise and fall required to free and stop the escapement-wheel are quite insignificant, but the escapement-wheel is so made that the parallelogram and detent can descend much further than is necessary simply to lock the wheel.

The instrument works as follows:—When no current is passing through the lamp the upper electrode descends until it comes in contact with the lower electrode, and presses down the oscillating parallelogram until the detent on the parallelogram stops the wheelwork, when no further motion can take place. As soon as the current flows through the electrodes which are thus in contact, the electro-magnet powerfully attracts the armature, and carries down the lower carbon to the required striking distance by depressing the whole oscillating system. The light immediately appears, and as the two points are consumed by the action of the current, the armature slowly rises, owing to the decrease of the current consequent on increased resistance. At a certain point the detent frees one tooth of the escapement-wheel; the wheelwork then revolves, and brings the two carbons a little closer, in much the same manner as in Duboscq's lamp, without, however, affecting the position of the oscillating parallelogram in the least degree. The current is thus again re-established at the required strength, and tooth after tooth is released, as the carbon points wear, by the almost imperceptible rise and fall of the oscillating system. If by any accident the current becomes too strong, the parallelogram removes the lower electrode a little further off, and by thus increasing the resistance, still maintains a constant current. If the current becomes suddenly much weaker (if, for instance, the light is blown out), the attraction of the armature ceases altogether, and the parallelogram springs up until the carbon points touch; at that instant the current is re-established, the armature again descends, and the light is in the same condition as before. The strength of current at which the detent is released simply depends on the adjustment of the spring which tends to lift the oscillating system; if this spring be weak, the detent will be released only when a very weak current is passing, and consequently the points will burn very far apart; if the tension of the spring be increased, the oscillating system will rise, even when a strong current is passing, and the carbon points will be kept comparatively close. The action of the lamp appears perfectly regular and to be depended on, and the details are extremely well considered. It has, however, one or two defects—the extreme sensibility of the oscillating system is in itself an evil, for the carbons never acquire a fresh position of equilibrium until after one or two oscillations; this defect is aggravated by the weight of the moving parts, which is necessarily large. The nature of the magnetic attraction, varying rapidly according to the relative position of the armature and the magnet, would be fatal to the invention were it not for the peculiar arrangement of the armature already described; but even this arrangement does not entirely remove the evil.

Two of M. Serrin's instruments were used in connection with M. Berlioz's electro-magnetic light, and either could at any moment be lighted or extinguished by simply turning a commutator—a most important advantage in many applications. For instance, this lamp could be used at the top of a mast, or under water, where other forms would be entirely impracticable. The light was tolerably constant, but was subject to occasional flashes which were very evident in the neighbourhood of the light, but which the inventor states are not visible at a distance.

W. D. Hart, Edinburgh (United Kingdom, 2,906), exhibits a lamp of entirely different and very ingenious construction. The lower electrode is fixed; the upper electrode is held in a brass rod roughened on its surface, and capable of a slight motion up or down. Round one part of this rod there is a hollow circular wedge of conical shape divided longitudinally into halves which are hinged to a common base, and tend to fall outwards. A ring surrounds this wedge, and is attracted to the armature of an electro-magnet to which it is attached, and which lifts the ring when a current passes. When the battery is not in action the roughened rod is in its lowest position, and simply rests by the upper carbon on the lower carbon; when the current is turned on, the armature of the electro-magnet lifts the ring, and compresses the halves of the hollow wedge which now grasp the rod; the upward movement of the armature and ring continues, and lifts the roughened rod and the upper electrode to the required distance from the lower electrode. This distance can be adjusted by screws. The lamp continues to burn until the current so far fails that the armature can no longer carry the upper electrode, the armature and attracted ring then fall down, the wedge loses its hold on the roughened rod, which by its own weight falls still further, until the two carbon points touch, when a powerful current is re-established, and the upper electrode again lifted to the original distance from the lower one.

This lamp may therefore be said to work by a succession of throbs; and it is difficult to believe that the light can be even approximately continuous. It can be readily adjusted to any size

of battery which can show the light, by altering the lift of the upper rod. It is also very simple and cheap. A committee of the Royal Scottish Society of Arts reported in 1858 that Mr. Hart's lamp gave as continuous a light as the electric lamps then before the public. It could be lighted at a distance by simply turning on the current.

(To be continued.)

LAND TELEGRAPH TO HONG-KONG AND THE CHINESE PORTS.

A COMMITTEE of the House of Commons, taken aback by some answers made to them by Brinsley, the hydraulic engineer, in regard to a project under consideration, asked him abruptly what he thought Providence intended rivers for? "What do I think Providence intended rivers for?" repeated Brinsley, "why, to feed navigable canals, of course!" If Brinsley was entitled to the joke for the sake of the good philosophy in it—though the Chinese, whose commerce depends so much on their canals, would probably think that his *raison d'être* for rivers was quite sufficient—much more might our utilitarian merchants be pardoned if they thought that God had created electricity with a special eye to the electric telegraph. In this mode of application it has subserved our highest worldly interests to an extent which could never have been anticipated. It has quickened all the pulses of the commercial world. It has gone far to annihilate the disadvantages, without impairing the benefits, of distance. It has brought London nearer to Glasgow, for purposes of communication, than Eaglesham or Busby, without causing our city to be obscured in the shadow of its mighty presence. It has brought the rich and fruitful countries that are washed by the blue waters of the Mediterranean Sea, within quicker reach than Campbeltown or Islay, without drawing them away from under their fructifying skies. In short, it has brought every place to which its magic wires are stretched far nearer for purposes of supply, while leaving them all their former advantages for purposes of production.

There is no nation on the earth to which the telegraph has become so important, and to which it offers such splendid advantages, as our own. It is one of our grandest boasts that the sun never sets on our possessions. Before he leaves us in the evening he is already smiling on our friends in Canada. Before he has lost sight of British America his beams are lighting up the distant shores of New Zealand and Australia; he turns his eye from Australia only to let it light on our vast empire in India; and before he bids good night to the Himalayas, he is kindling the golden ball of St. Paul's Cathedral, and the gilded vanes of our Glasgow churches, and calling our teeming millions to their daily work. To connect these scattered portions of our vast empire—to knit them together as by a beautiful and delicate nervous system, so that all the parts, with the advantages of separation, shall enjoy the advantages of proximity, and the remotest extremities shall feel and thrill with every pulsation of life from the central heart—this is a work which one agency alone can effect, and that agency is *the telegraph*. The splendid advantages to be derived in every way—political, military, and commercial—from bringing our colonies and dependencies into constant, easy, and rapid communication with one another, are too obvious to need specification; and our Government, we are glad to see, is becoming more and more alive to its importance.

Last month we called attention to the approaching completion of the telegraph wires from England to India, *viâ* Arabia and the Persian Gulf, and to the good prospect there now is of seeing the telegraphic system of Europe and India speedily united by this route. We shall thus be in full telegraphic communication with Calcutta, and—*viâ* Calcutta—with Rangoon and Shooe-Gyen (Shway-Gyeen) in Eastern Pegu, over the following distances, in geographical miles:—

London to Belgrade, in European Turkey	900
Belgrade to Constantinople	450
Constantinople to Bussorah, in Asiatic Turkey	1100
Bussorah to Kurrachee, in British India	1050
Kurrachee to Calcutta	1155
Calcutta to Dacca	135
Dacca to Rangoon	480
Rangoon to Shooe-Gyen	130

This gives a total air-line length of 5,400 miles of telegraph from England eastward; or, by the addition of one-fourth to cover deviations in following existing roads along the route, about 6,750 geographical miles in all. Of these, there will be 5,625 miles (that is, the entire line, save from England to Belgrade) either on British territory, or under British control, and worked by English signallers. We are thus on the eve of realising what may well take its place as one of the greatest wonders, and certainly one of the most valuable achievements of this age—an unbroken line of telegraphic communication from England to Shooe-Gyen, on the south-west of China.

There are few of our merchants, if they look at their maps and follow the route we have described, who will not feel their mouths watering, in a figurative sense, when they find the telegraph so *terminating* in Pegu. Their eyes will traverse, with eager and wistful glance, the narrow overland space that separates Shooe-Gyen from that mighty gateway of our commerce with China—Hong-Kong; and they will naturally ask themselves WHY the Home and Indian Governments, having wisely and successfully carried the wires so far, should not carry them the little farther that is thus needed to bring Hong-Kong into direct telegraphic communication with London? The distance, compared with that which will so soon be traversed by the telegraph to India, is insignificant, and 120 miles of it would be over British territory. We should then, according to the detail statement of the Messrs. Sprye hereon, have 279 miles from the north-east frontier of British Pegu, across Burmah, by the cities of Kiang-Tung and Kiang-Hung, to Sz-mau (Esmok) on the south-west frontier of China. Thence along the imperial roads, down the Pearl and West River valleys, through six or seven of the principal Southern Chinese cities, to Canton, would be 757 miles; with 70 more from that city to Hong-Kong. These distances yield a total of only 1,226 geographical miles, or, by adding one-fourth, as before, for deviations, 1,534.

Being then on the eve of completing an unbroken line of telegraphic communication from London as far as Eastern Pegu, a distance of 6,750 geographical, or about 7,100 English miles, it becomes a question of great and pressing importance, especially to our merchants and shipowners, in view of the vast interests which we now have springing up in China, whether the Home and Indian Governments should not take the steps necessary for carrying the wires over the 1,500 miles of land that separate us from Hong-Kong. The project is not new. For several years the Messrs. Sprye, whose names are well known in connection with our commercial system in the East, have been pressing on both Governments the importance of thus extending the Indian wires, *by land*, from Pegu to Hong-Kong and the open ports of China; and have spared no pains in endeavouring to satisfy them and the public as to the practicability of the proposal. In anticipation of the completion of our telegraphic connection with India and Eastern Pegu, their project (which embraces the opening up of trade with the whole of the rich inland provinces of Western China) is daily attracting a larger share of public attention; and the Manchester Chamber of Commerce have now, for a second time, memorialised the Government in its favour. Having stated its nature and extent as fully as our space allows, we may proceed, when leisure permits, to discuss its manifest merits, for England and India, over the Russian-Siberian-Mongolian line to the north of China.—*Glasgow Herald.*

THE CONSERVATION OF FORCE.

IF a boy snaps one marble against another of the same weight with such precision of aim that the two come in contact exactly in line of their centres, the marble that is snapped will stop in place of the other, while the one that is hit will move forward with the same velocity as the first and in the same direction. The marble first set in motion loses its force, but this force is not destroyed, it is transferred to the other marble, and is thus preserved—or conserved. As action and reaction are equal, it is held as a self-evident truth, that matter once in motion can be stopped only by setting some other matter in motion, and this principle is called the conservation of force.

This doctrine is now generally associated with that of the mechanical theory of heat. It is supposed that the universe is filled with an extremely subtle fluid, imperceptible except through its vibrations to any of our senses. The theory further imagines that the minute particles of this fluid have vibrating motions of various kinds. If we fasten one end of a clothes-line to a post, and

take hold of the other end and shake it up and down, we shall see undulations or waves run along the line. The several particles of which the cord is composed do not move in the direction in which the waves move, but while each wave starts at one end of the rope and runs to the other, any given inch of the rope simply vibrates up and down. If we shake the end of the cord horizontally, we shall produce vibrations in a different direction; and if we whirl the end around in a circle, we shall produce those of a still different character, the waves will be apparently spiral, though each particle of the rope will be revolving in a small orbit. There are other kinds of waves conceivable in the particles of fluid which cannot be represented by a rope.

Now, the theory is, that one kind of vibration in the ethereal fluid produces the effects and the phenomena which we call heat; another kind light; another electricity; another magnetism; and another chemical affinity. It is supposed that when heat is converted into electricity, the peculiar vibrations which affect our senses as heat are stopped, and that in stopping they start those vibrations which we recognize as electricity.

It is also supposed that when a body is heated, the heat vibrations of the ethereal fluid are imparted to the several atoms or molecules of the heated body. And, as all the substances with which we are acquainted are more or less warmed, it would follow that all of their particles are in continual motion. In the same way, when a body is electrified, its particles are presumed to receive the electric vibrations.

The fact that light, heat, electricity, magnetism, chemical affinity, and mechanical force are all mutually convertible one into another, is one of the strong arguments in favour of the truth of this theory.

This theory is the most comprehensive that has ever been conceived by the mind of man. It proclaims that all of the varied and complex phenomena of the universe, from the revolutions of the nebulæ to the growth of a lily, result from the single fact, that matter has got in motion and cannot stop. It recognizes but one force in the universe, *vis viva*, or the force of moving bodies. It also suggests the possibility of explaining all phenomena, leaving one circumstance only beyond the pale of human knowledge—what it was that first set matter in motion.

THE ORIGINATOR OF SUBMARINE TELEGRAPHY.

WE quote the following communication from the *Scientific American*, of the 14th inst.:—

Will you allow me a little space in your excellent journal to correct an error of fact, respecting the origin of submarine telegraphy, to which my attention has been specially directed in a marked number of the *Telegraphic Journal*, of London, sent me thence by an unknown friend.

In a notice in that journal of April 2nd, of the late Mr. Brett's collection of pictures, there is this incidental remark, "The late Mr. J. W. Brett, who was designated by Professor Morse, *the father of submarine telegraphy*, &c."

I have never designated Mr. Brett, nor any one else, "father of submarine telegraphy," having always claimed to have first proposed, and personally laid and operated the first submarine telegraph myself.

Mr. Brett I knew well; he was a personal and highly-esteemed friend, and I knew that he supposed himself to be the first who had proposed a submarine line in 1845. In conversations with him I always insisted that not only the first proposal, but the first actual execution and operation of such a line belonged to me. I told him I had unanswerable evidence of the fact. This announcement to him I saw gave him uneasiness, and after I left Paris in 1858, for Porto Rico, he wrote me a letter under date of November 15, 1858, in which he asked me to give him the history of my connection with submarine telegraphy. To this letter I replied from Arroyo, Porto Rico, December 27, 1858, quite at length, giving him minutely its history. In that letter (a press copy of which I have by me), I showed him that at least as early as 1838, I had made the proposition of an Atlantic telegraph to Robert Walsh, Esq., the American Consul in Paris; for Mr. Walsh testifies to that fact of his own move, without my knowledge at the time, in one of the American journals, of which he was the foreign correspondent. But I referred him also to my letter of September 27, 1837, to the Secretary of the Treasury, published in the Congressional documents, in which letter I suggest the submarine method of constructing a telegraph line. I referred him also to my letter to another Secretary, in August, 1843, in which I make the distinct prediction of a future Atlantic telegraph, as a deduction from experiments I had made. For in the autumn of 1842, I had carried into effect the proposition of a submarine line in the harbour of New York, laying out the line personally from Castle Garden to Governor's Island. This was an acknowledged success by the journals of the day, and for this success I received the gold medal of the American Institute. This medal fixes a date (1842) unmistakeably. Mr. Brett rests his claim on the fact that, in 1845, he addressed a letter to the British Government, proposing oceanic and subterranean telegraphs. The year 1845 is the earliest date to which he appeals, and at that date he had only suggested a plan of submarine telegraphs to the British Government, while three years before I had actually constructed and operated, in New York harbour, a submarine telegraph line.

It is obvious, therefore, that I could not have designated Mr. Brett as the "father of submarine telegraphy." The *Telegraphic Journal* marks these words professedly, as a quotation from a written or printed document of mine. I have never written or printed any such admission. The nearest to such an admission is the following extract from the historical letter alluded to, which I wrote to Mr. Brett. After giving him a detailed account of the steps I had taken in submarine telegraphy, I say, "I have read your account of the origin and progress of the ocean telegraph with deep interest, and if chronology, by its rigid dates, gives the origin of submarine telegraphy to me, it cannot detract from you the undoubted merit of having independently originated the project of submarine intercommunication, and successfully carried it out, too, in Europe, to a useful result. I esteem and honour you as the *Father of European Submarine Telegraphy*, and I rejoice that both the honour and the profits have been so justly awarded to you."

In thus awarding to Mr. Brett, in that letter, the honour of being an independent originator of "European Submarine Telegraphy," I ought to say that if there are other claimants to that position in Europe, I do not pretend to decide between them. I based my remark to Mr. Brett solely on his representations to me, believing him to be, as he was, an honourable and high-minded, as he certainly was, a generous and worthy man. If the supposed admission on my part that Mr. Brett was the "father of submarine telegraphy," is founded on this letter of mine to him, it is seen at once that it is a misquotation in the *Telegraphic Journal*, and (as I am willing to believe) through mistake, the important qualifying word "European" was left out, which is necessary to be inserted to make the quotation conform both to my letter and to the truth of history.

New York, April 26, 1864. SAMUEL F. B. MORSE.

THE PERSIAN GULF TELEGRAPH.

OUR last detailed notice of the Persian Gulf telegraph expedition extended to the landing of the end of a section of the cable on the isthmus (Muklub) which separates the Gulf of Oman from that of Persia, and we mentioned that, while waiting for the Tweed and Assaye to arrive with further sections, Colonel Stewart, Colonel Goldsmid, and Sir Charles Bright proposed to pay a hasty preliminary visit to Bushire, Bussorah, and Fao, for the purpose of inspecting the arrangements made at those places for landing the cable ends, and establishing permanent stations. However, after the vessel which brought us that intelligence left, Colonel Stewart thought it advisable to accompany Colonel Disbrowe, the British agent at Muscat, to that place. Accordingly, the Coromandel went to Muscat with all her party except Colonel Goldsmid, who remained at Mussendum; and we understand that an interview which Colonels Disbrowe and Stewart had with his Highness Syed Soweynee, the Sultan, resulted in arrangements likely to be very advantageous for the protection of the telegraph cable where it passes through his territory.

Colonel Stewart having completed his business at Muscat, and the Coromandel having taken in sufficient coal for the rest of her work in the Gulf, she returned to Mussendum: not, however, to Malcolm's—which, as we before explained, is the inlet on the eastern or Oman side of the promontory —but to Elphinstone's inlet, which is on the western or Persian Gulf side of Ras Mussendum. On a small island in this inlet, and not on the mainland as at first intended, the telegraph station has been fixed. This rocky island of bare limestone is just large enough for the purpose to which it has been put. At present all the officials who are to remain there are in tents; but Colonel Stewart has designed a most commodious building, for which the island itself and the neighbouring rocks will afford an unlimited supply of excellent stone.

The Arabs of the villages about the inlets—who, before Colonel Stewart's visit to the Imaum of Muscat, were rather inclined to be troublesome—are now very well behaved, so that there seems to be little or no reason to fear that, even in wantonness, they will do any injury to the cable where it crosses the narrow isthmus between Malcolm's and Elphinstone's inlets; and a visit which the Imaum proposes to pay to the spot very shortly is likely still farther to foster the goodwill which they seem now inclined to exhibit towards our people. Besides, there can be no doubt that people so utterly devoid of property as these will not lightly do anything which might put an end to the solid advantages which are constantly accruing to them in the shape of presents and liberal pay for very light work. In addition to the accommodation on the island, there are two hulks comfortably fitted up as dwellings for the telegraph employés. One is moored off each end of the island. These hulks are the old Indian navy vessels Euphrates and Constance, both of which have done good service in their day. We can well believe that the Indian naval officers who accompanied the expedition could not restrain a sigh at seeing the vessels, in which they have often braved the dangers of the deep with friends and companions now scattered far and wide, converted into mere hulks, however useful the purpose to which they are to be applied. When the question of what name should be given to the

island and station was mooted, it was purposed to call them after Colonel Stewart, but the colonel himself decided that it should be called after the inlet, Elphinstone Island. The view around it is not beautiful, but grand and imposing; encircling it is the calm, clear water, blue from its great depth, and almost always so still as to reflect, with photographic accuracy, the clear, sharp outlines of the stern, towering, bare rocks, which seem almost to enclose an inland lake.

Fish of various kinds are almost the only kinds of food afforded by the place itself; rock oysters are very plentiful, and almost every day some of the party set out with hammers, and bottles of the proper piquant accompaniments, in order to vary the monotony of their ordinary repasts by a dozen or two of "real natives." The amusement, however, is not open to every one, as on many stomachs these oysters seem to produce much the same effect as Dr. Cockle's antibilious pills—at least they get the credit of doing so. A few fowls and eggs are the only other kind of food to be got at Mussendum, and the stock of these in the neighbouring villages is already nearly exhausted.

But arrangements have been made to secure a constant supply of all kinds of food, &c., from the island of Kishm (Bassadore Island). The intention which originally existed of ultimately fixing the station at the town of Kussab, which lies at the entrance of the inlet, has, we believe, been quite abandoned, as there is every reason to believe that any advantages which that place may at present possess over Elphinstone Island are easily obtainable for the latter; while its disadvantages—in a sanitary point of view, and from want of shelter for the hulks in bad weather, as well as the distance at which it is situated from the point where the cable crosses the isthmus, and where it is, of course, most liable to injury—are irremediable.

We fear we cannot describe the Elphinstone Island Telegraph-station as a favourable resort for those who have it in their power to select a place of residence; but we do not see why, when permanent buildings have been erected, water-condensers and ice-machines set to work, and a regular supply of fresh food is kept up, it should compare at all unfavourably with Aden; and our readers are probably aware that statistics prove Aden to be the second healthiest station of the Bombay army. Elphinstone Island, too, will possess at least one advantage over Aden, for though it will not have a weekly mail from England, yet it will be in hourly communication with the whole of Europe, and those stationed there will know the great events of the day before the Viceroy himself.

Colonel Stewart has not neglected any available means of rendering the expatriation of the telegraph employés as little irksome as possible; he has provided each station with a good library, carpenters' tools, rifles for rifle-practice, boats, &c. Till arrangements can be made for a Royal navy vessel to be stationed at Mussendum, the guardianship of our people is committed to the Bombay marine gunboat Clyde, commanded by Lieutenant Hewitt, of the Indian navy; she will probably be shortly relieved by the Hugh Rose. Each of the hulks also has a brass 24-pounder under the charge of an European gunner.

All the arrangements we have been describing were made between the completion of the first section of cable (from Guader to Elphinstone Island) and the arrival of the Tweed and Assaye with the next sections—those from Elphinstone Island to Bushire and on to Fao. On the 12th of March the Zenobia arrived with the Tweed in tow, and a day or two afterwards the Semiramis brought in the Assaye. At the same time the Victoria came in from Kurrachee towing the flat Hyderabad, which is to be used as a hulk at Fao. The Dalhousie next made her appearance with the two hulks already referred to. When these vessels arrived, they found the Coromandel and the gunboat already there, so that for a few days Elphinstone Inlet saw a sight which it never saw before, and is not likely soon to see again—six steamers (three paddles and three screws), four sailing-vessels, and a flat riding at anchor together.

The ships having arrived, no time was to be lost in continuing the laying of the cable, so the Zenobia was sent off without dropping her anchor to coal at Bassadore, and in the meantime the shore end of the Tweed section of cable was landed on Elphinstone Island, and attached to the same instrument as that to which the extremity of the section from Guader had already been laid. The Zenobia came in on the 18th, and the same afternoon she took the Tweed in tow, and proceeded out of the inlet and on her course for Bushire, the cable paying over the Tweed's stern with the utmost regularity and ease. The weather continued as favourable as could be desired during the whole time, and in less than eighty hours 360 miles were laid down without a single hitch of any sort, and what was most gratifying, it was found that, as the cable became subject to the pressure of the sea, so its conducting powers improved. The section on board the Tweed was, as had been anticipated, exhausted about fifty miles to the east of Bushire, off a part of the Persian coast called "the asses' ears;" the Assaye was then brought close to the Tweed, and the beginning of her cable spliced on to the end of that just laid down; this done, the Zenobia took the Assaye in tow, and proceeded with her into Bushire Roads, where the end of the cable was landed by the telegraph steamer Amberwitch. Thus the telegraphic chain from India to Europe was completed as far as Bushire. On the following day (25th of March) the Amberwitch landed the end of the next link towards the west—viz., that from Bushire to Fao—the station at the mouth of the Euphrates where the submarine communication is to give place to the overland. Indeed, the land-line from Fao to Bussorah is already completed. When this piece, about 140 miles in length, to Fao was laid, as it was to be the day after the Semiramis started for Bombay, the only link wanting in the long chain from India to England would be part of the distance from Bussorah to Bagdad, which, as we before stated, would have been completed ere this but for the opposition offered by the wild Arabs of the district.

We were very sorry to learn that Lieutenant-Colonel Stewart had been unwell for two or three weeks while lying in Elphinstone Inlet, after returning from Muscat, though we are happy to be able to state that when the Semiramis left he was quite recovered, and able to attend to business as usual.

The particulars given above regarding the progress of this great work left the submarine cable at Bushire on the 25th of March. On the following day the laying down of the remaining portion from Bushire to Fao, at the mouth of the Euphrates, was proceeded with; and on the evening of Easter Sunday, March 27, the ship anchored in the Khor-ab-Dallah, a shallow delta very near the spot at which the terminal station of the submarine line has been established. Thus far the great bulk of the work was successfully completed, but there still remained one operation, which was, perhaps, the most difficult of the whole. The end of the cable had to be carried from the Khor-ab-Dallah across a spit of mud some miles wide at Fao. The difficulty which first presented itself was to get the cable across the six or eight miles of shallow water which intervened between the cable-ship (Assaye) and the edge of the mud-bank. This could only be done in a flat-bottomed boat, and accordingly the Comet, a flat-bottomed steamer belonging to the Bombay marine, and commanded by Lieutenant Bewsher, which does the Government work between Bussorah and Bagdad, was put into requisition, her two 9-pounders and all her coals having been taken out in order to make room for the cable. At first it was proposed to land the cable on the Khor-ab-Dallah side of the mud-spit, and carry it across to Fao, but ultimately another course was adopted. Enough cable to stretch across the mud-spit to the Khor-ab-Dallah was placed in the Comet; one end of the piece she delivered on board the Hyderabad, a flat-bottomed hulk moored off Fao, which for the present, at any rate, is to be the telegraph-station; the other end was taken on shore, and laid along a trench through the mud which had been prepared for it. Off the Khor-ab-Dallah end of the trench the telegraph steamer Amberwitch, Lieutenant Stiffe, was waiting with another section of cable; the end of this was spliced on to that in the trench, and the Amberwitch steamed away towards the buoyed end of the main part of the cable, paying out as she went along. When we reached the Assaye, the buoyed end was picked up and spliced on to the section of cable that had just been paid out, and the telegraphic communication between India and the Euphrates was complete. This took place on the 8th of April.

But between the anchoring of the telegraph squadron in the Khor-ab-Dallah on Easter Sunday and the completion of the work to Fao an accident happened to the cable, which, though at first the cause of a good deal of annoyance on account of the suspension of communication with India which resulted from it, ended in giving increased confidence in the work, by showing with what ease such accidents as must necessarily be anticipated can be repaired. During the above night, March 27, and up to eleven o'clock the following day, the communication along the line was perfect; and reports of the progress made were sent to the Governor-General and Sir Bartle Frere; a good deal of business connected with the expedition was also transacted through the cable, but the wire became suddenly dumb, and the electricians at once saw that a solution of continuity had taken place somewhere. The question was, where and of what nature was the break? Of course there could be no doubt as to which section was the faulty one; it could only be the last—that from Bushire—because the piece of cable extending between any two stations is complete in itself, and quite distinct from any other; though the further end of one section and the near end of another are always attached by the same instrument, and can be readily brought into direct communication. But though the possible locality of the break was thus limited to one section, yet that section is nearly 150 miles long, and the fault might exist in any one of the 264,000 yards of cable of which those 150 miles consist; and all these 264,000 sites of the fracture had an average depth of 25 fathoms—that is, 150 feet of water over them. Yet—will our readers believe it?—within half-an-hour of the cessation of communication through the wire, the exact locality of the fault was determined to within a third of a mile, and even the extent of injury to the cable was ascertained. It was found that the wire only was affected, its gutta-percha covering, and the outside casing of iron wire, &c., remaining intact. The distance from the anchorage to the break was calculated at 90½ miles. When we hear that all these particulars of the accident were confidently stated within half-an-hour of its occurrence—that all the preparations for repairing the break were based upon them with as much confidence as if they had been mathematical certainties—and that they were found to be absolutely correct, must afford the highest gratification. This is a noble result of the "philosophy of fruit," as Lord Bacon loved to call the system of investigation to which he was the first to call men's minds.

The Amberwitch (which is fitted up with every convenience for paying out or repairing the cables), with Messrs. Webb and Woods, the principal members of the engineering department of Sir Charles Bright's staff, proceeded towards the spot at which the tests from the Khor-ab-Dallah side showed the fault to lie, and there she met the Zenobia returning with the

electricians from Bushire, the tests from that side having, as we before mentioned, given the same results as those from the Khor-ab-Dallah. Mr. A. P. Young, late Indian navy, who, with Commander Bradshaw, R.N., of her Majesty's ship Severn, has been engaged in preparing charts of the exact positions of the cable, was on board the Zenobia, and according to the directions furnished by him from the chart of the cable, Lieutenant Carpendale, the commander of the Zenobia, laid down a buoy almost exactly abreast of the fracture. In the immediate neighbourhood of this buoy, the Amberwitch began to drag with a grapnel across the course of the cable, and in about seven or eight hours the cable was hooked, and a "bight," or loop of it, dragged up to the bows of the vessel. It was immediately cut through, and one end, with a buoy attached dropped into the sea, while the other was coiled down in the vessel as she steamed towards the exact point at which the tests continued to show the defect to lie. When the steamer came over the exact spot, and the broken part of the cable began to be raised off the ground, the electric current began to flow through it again as if it were perfect. This was the result of the bending of the cable as it left the ground, which caused the broken ends of the wire to come again into actual contact. As soon as the part in which the fracture was had been got on board, the cable was again cut, the end of a new one spliced on to it, and the Amberwitch steamed back, paying out the new piece as she went along, till she reached the end which had been buoyed; to it the end of the new piece was spliced. The whole operation of dragging for the cable, cutting it, inserting about two miles of new, and making two splices, each splice occupying about six hours, was completed in less than forty hours, and would have been done more rapidly had not two joints, when partially completed, required to be made over again. Very great credit is due to the gentlemen of Sir Charles Bright's staff who effected the repair, and to the marine surveyors whose accuracy in delineating the exact course in which the cable was laid, rendered it possible to determine at what exact point any given length of cable would have been passed over. These particulars being furnished to Lieutenant Stiffe, his intimate knowledge of the Persian Gulf enabled him to steam straight to the point indicated. When it is considered how many different classes of facts have to be accurately ascertained before any particular part of the cable can be hit upon, the rapid approach towards perfection in submarine cable-laying which the laying of the Persian Gulf cable shows, will be more thoroughly appreciated.

The Amberwitch having returned to the Khor-ab-Dallah, and the weather, which had become exceedingly boisterous, though fortunately not till after the repair of the cable had been completed, having moderated sufficiently to allow of the end of the cable being picked up, the extreme end was again brought into communication with the galvanic battery, and messages passed to and fro through the whole length of the line—that is, through 900 miles of cable, between the Khor-ab-Dallah and Guador.

Reference was made at the beginning of this article to the completion of the cable-laying from the Khor-ab-Dallah, up to the telegraph hulk Hydrabad at Fao, but we believe it is almost impossible to convey by word an idea of the tremendous difficulties over which British "pluck" and determination have triumphed in this part of the work. One mile had to be laid through mud so soft that the men engaged in laying it, and the engineers who were superintending them, could not stand upright at all, but had to drag the cable after them as they propelled themselves in a sitting position; and when they did reach firm ground—the mud-spot above referred to which separates the Khor-ab-Dallah from Fao—the cable had to be cut into mile-and-half lengths and carried by hand: in this work several hundred Arabs were employed. Across the mud-spit the cable is buried in a trench about thirty inches deep. This was dug under the superintendence of Lieut.-Colonel Goldsmid and Commander Bradshaw, who, regardless of discomfort, took up their quarters in a tent in the middle of the mud. Colonel Goldsmid, with Mr. Johnson, the Vice-Consul at Bussorah, made the necessary arrangements for securing Arab labour, and Commander Bradshaw laid down the course of the trench.

The manner in which all the members of the expedition work together for the attainment of their common end is most commendable; and no small share of the happy result must be attributed to the Director-General, Colonel Stewart, and to Sir Charles Bright, whose kindliness and urbanity generally prevented any of the clashing and jarring which but too often occur where a great number of persons of different professions are associated in an undertaking of moment and responsibility, and where a somewhat ambiguous authority is delegated.

We have now, in our successive accounts of Colonel Stewart's expedition, traced the course of telegraphic communication between India and Europe, to the point where it ceases to be under direct British control. A message from any part of India passes the Indian frontier at Kurrachee, is sent along the land line (250 miles) to Guader on the Mekran coast of Beloochistan. At Guader it is transferred to the submarine cable, by which it is conveyed to Fao at the mouth of the Euphrates, having passed through and been repeated at Elphinstone Island (Mussendum) and Bushire. At Fao it is transferred to the Turks, who send it along their land line to Bussorah, and on towards Bagdad as far as the line is completed. At present about 170 miles of the distance is incomplete; the unfinished portion lies between two completed parts, the work having been pushed on simultaneously from each town. Over the unfinished part the message is conveyed along the river by steamer or by *kossids*—that is mounted horsemen—who travel as nearly as possible in a state of nudity, so as to offer no temptation to the cupidity of the lawless inhabitants of the country through which they pass. Coming again upon the telegraph, it is sent still by the Turks through Bagdad and Mosoul (Nineveh). A telegraph station amid the ruins of Nineveh! Then across the Persian frontier to Diarbeker, and on by Sivas and Angora to Scutar, where it crosses to Constantinople.

We need not trace its course farther. Even in the present incomplete state of the line between Bagdad and Bussorah, a message from England which reaches Bagdad at the time when one of the river steamers is starting for Bussorah, may be delivered in India in about $4\frac{1}{2}$ days; but one going the reverse way, and which must be conveyed by a *kossid*, or against the stream in a steamer, will take two days longer.

We are happy to say that Colonel Stewart anticipates a speedy solution of the difficulties which impede the completion of the line in Mesopotamia; they arise solely from the hatred borne by the Arab inhabitants to their Turkish masters. Their feelings to the English are very friendly, and if the Turkish Government would permit us to construct the line it might be easily completed; but they are exceedingly jealous of us, and insist on doing it themselves, while the Arabs seize every opportunity of annoying and obstructing them. As may be imagined, the Turkish authority over such lawless people is merely nominal, and does not really extend beyond the nomination of their sheik or governor. But recently they have been endeavouring to gain a firmer hold, and with that view endeavoured to purchase the title to the soil. To this the sheik consented, and went to Bagdad to conclude the arrangement; but the Arabs refused to allow their birthright to be bartered away, or to submit any longer to the authority of the man who had attempted to barter it; accordingly they broke out into open rebellion against the Turks and their sheiks; hence the interruption to the telegraph. Now, however, the Turks have consented to appoint a new sheik, and one who is favourable to the work; he will be invested at Bagdad immediately. Colonel Kemball, the British Resident at Bagdad, has been chiefly instrumental in bringing about these amicable arrangements; but he did not succeed in doing so without very great difficulty, nor until the Pasha at Bagdad had received orders from the Porte to be guided by his advice.

Our last news from the Euphrates left just as Colonel Stewart was starting for Bagdad, to consult with Colonel Kemball regarding these and other matters. He was to be accompanied by Sir Charles Bright, Colonel Goldsmid, and his personal staff. The Bombay marine steamer Coromandel was to convey them as far as Bussorah; the rest of the passage was to be made in the flat-bottomed steamer Satellite, which had just arrived in the river; she is made over to the telegraph department.

The Bombay Marine has played a most important part in the laying of the cable. The superintendent, Captain Young, C.B., late Indian navy, directed the whole of the marine arrangements, having the cable-ships fitted for the work on arriving from England, providing towing-power for the paying-out ships, and vessels for the despatch of the large quantities of stores required at the different stations. We understand that Captain Young's arrangements have been most complete and satisfactory, which indeed is proved to be the case by the fact, that no delay or accident has occurred to any of the large number of vessels employed. There have been no less than nine steamers engaged in the work—six of them large sea-going vessels, the other two flat-bottomed river boats, and in addition to these which have been actually employed in the paying-out operations, at least seven large ships have come round the Cape with stores and the cable. The Coromandel has been the head-quarters' ship throughout the expedition, being commanded by the senior Bombay Marine officer, Lieutenant G. O'B. Carew, late I.N., through whom Colonel Stewart conveyed all his instructions to the commanders of the other vessels. Colonel Stewart and Sir Charles Bright, when cable-laying was not actually going on, lived on board her. She was sometimes employed in piloting and sometimes in towing. The Zenobia, paddle steamer, commanded by Lieutenant T. C. R. Carpendale, late I.N., was employed in towing the cable-ships while actually paying out. She has greater power than any of the other paddle-steamers which were employed in the expedition, and Lieutenant Carpendale and his officers quickly got accustomed to the kind of duty required of them, and by their close attention to the directions constantly sent from the cable-ship, greatly facilitated the ease and success with which Sir Charles Bright and his staff were enabled to carry out the delicate operation of paying out the cable. We anticipate Colonel Stewart's official report on the operations with great interest.

The only work now remaining to be done, is the laying of a piece of cable along the Mekran coast from Guader to Kurrachee, as a supplement to the land line which already exists there. As we before mentioned, the land-line has been working most satisfactorily for about a year; but in so important a matter as the telegraph between India and England, it is thought best to use every possible means of securing an uninterrupted communication.—*Times of India.*

NEAPOLITAN TELEGRAPHS.—The telegraph in Naples was inaugurated, under the auspices of the State, on the 31st July, 1852, and has since been extended in a very satisfactory manner, although at some expense to the Government. The telegraph offices now open in the kingdom of the Two Sicilies number 248, producing 1,370,000f., while the expenditure has amounted to 1,736,000f. We appear to be able to manage these things better, and at less cost in England, by private enterprise.

ON THE PATENT LAWS.

DISCUSSION.

(*Continued from page* 250.)

Mr. WALTER HANCOCK said that the policy and operation of the patent law had been forced upon his attention by an experience of its working for nearly twenty years. No one could deny that that working was unsatisfactory, sometimes grossly unjust; so much so, that it was even possible (as was suggested by Mr. Hawes) for a man to have his invention snatched away from him, and if he neglected to follow it up closely to the doors of the Patent-office to see, by operation of law, the legal title to his property conferred upon another. But this monstrous scandal, although within the letter of the law, was diametrically opposed to its spirit; it was an evil not necessarily inherent in the law, but possible only from its present lax and clumsy administration. To an enterprising manufacturing country like ours, the subject was one of great importance and of great difficulty. The views entertained as to the policy of any law for the protection of patent right were as wide asunder as the poles, for inventors too often insisted that it was the duty of the State to establish a system for their especial and ample protection, overlooking the fact that the law owes duties to the public as well as to the inventor; on the other hand, persons entitled to great weight maintained that the policy of patent right was essentially vicious, and opposed to the principles of a sound economy, inasmuch as it created a monopoly. Between these two extremes there was ample room for a sound and beneficial law. The staunchest opponents of patent right would not deny that the inventor of a new and useful invention was entitled to a substantial reward of some kind. We were told, indeed, by a few that invention, like virtue, would prove its own reward; this would only apply to the pure philosopher, who pursued the study of science for its own sake. We were told that the State should reward inventors, but what was to be the nature of this State reward? A decoration, a riband, or a nomination to a legion of honour? He did not wish to undervalue these acknowledgments, but they were not the considerations that would weigh with the body of our countrymen as a stimulus to invention. Then we were told that the State ought to give pecuniary rewards. He maintained that it would be impossible to work out such a problem either satisfactorily or economically. How difficult it was now to get the Admiralty or any Government body to appreciate or take up any new invention, however valuable. If a department of the State were charged with the duties of examining and dispensing rewards for new inventions, was it not probable that instead of 3,000 we might have 30,000 claimants per annum? And should we not require for this purpose a machinery and a body of experts more extensive and costly than that which was advocated for the preliminary examination of patents? Another serious objection would be that these rewards would be a heavy charge upon the State, whereas the present law was not only self-supporting, but left a surplus, which, as Mr. Webster justly said, ought to be applied wholly to the encouragement of invention. He could not but come to the conclusion that for the people of this country, who appreciated everything by its value in pounds, shillings, and pence, the only feasible reward was the commercial one, such as was conferred by patent right: because such a reward would usually be as nearly as possible equivalent in value to the benefit which the public themselves (by the purchase of any patented article or process) considered that the inventor had conferred upon them by his invention. Now it was easy to "give a dog a bad name," to raise an unfair prejudice against patent right by stigmatising it as a "monopoly," as a remnant of the laws of olden times. He considered that Mr. Webster had demolished the argument that patents were monopolies, by showing that they deprived the public of no existing right or benefit, because they referred only to new trades or processes created. He (Mr. Hancock) must demur to the proposition of the chairman of the council, that "patent right was a remnant of the law of olden times." Placed side by side with invention, patent law was of comparatively recent date. In olden times there was no patent law; there was no necessity for it; nor was there any necessity for copyright. Inventions were "few and far-between," and it was while in the actual enjoyment of that reward for which the author or inventor of the present day had to strive so hard, that many of the great works and inventions of old were completed. To what higher reward could Virgil aspire, when engaged upon his Æneid, than the patronage and bounty of Augustus? Or Horace than that of Macenas? Was it not at the court of Hiero, of Syracuse, that Archimedes made the great discovery of specific gravity? But, if the proposition were correct, that patent right was a remnant of the laws of olden times, that alone would be no argument for its abolition. If we wished to descend from the proud position that we occupy of being the greatest, freest, richest nation in the world, we could not do better than begin by abolishing some of our laws of the olden time, such as trial by jury, which was said to have existed about 1,000 years, Magna Charta for about 650, and Habeas Corpus, which might be said to date from the same century as our patent right. He contended that what was vicious in the olden laws of monopolies was abolished by the Act of 1624, and that the legislature exercised a wise discretion when they excluded from its operation the patents for inventions. So far, therefore, from regarding patent right as a law that ought to be abolished, he looked upon it as a necessity of the present time. This subject had been fully discussed at the meeting of the British Association at Manchester in 1861. Mr. Curtis (then Mayor of Manchester) gave a striking instance of the necessity of a patent law. His firm had spent upwards of £10,000 in the perfecting and introducing a new machine; without a patent right it would have been open for any engineer to have availed himself of all this outlay, and actually to have made and sold the improved machine, and got a profit, at a price at which the inventor himself, with this outlay to make up, could not possibly compete. If the opponents of patent right charged its advocates as monopolists, surely their own principles too nearly approximated to those of the communists. He (Mr. Hancock) could give a more striking instance, drawn from his own experience, of a new invention and manufacture that would not have been prosecuted but for the patent law. About twenty years ago there was introduced into this country and to this Society a substance new to us—gutta-percha—and for the introduction the Society rewarded Dr. Montgomerie with its gold medal. It was introduced as a scientific curiosity, in the hope that means might be devised for rendering it a useful material in the manufactures of this country. Hitherto it had answered no such purpose, although it had existed for probably 5,800 years. It could not be obtained without great difficulty; it was necessary to penetrate tropical forests, inhabited by tigers, at a distance of 15,000 miles from home. It was not, therefore, without considerable labour and enterprise—it was not, in fact, until after the undivided attention of three gentlemen for a period of three years, and the assistance of others, and at a total expenditure of nearly £25,000, that any manufacture for profit could be attempted. He would confidently ask, would the inventors and capitalists have combined to do this but for the protection of the patent laws? What had been the result? The public had been largely benefited by the many purposes to which this substance had been applied, but especially by its application to submarine telegraphy. When we recalled that the old Atlantic cable by one message saved this country upwards of £50,000, that during the Crimean war the Black Sea cable was estimated to have saved this country upwards of £1,000,000 and that besides this we had for twelve years enjoyed submarine telegraphic communication with the continent, it must be obvious that the benefits, direct or indirect, conferred upon the public by gutta-percha were incalculable. He would grant that the gutta-percha patents had produced an immensely handsome reward. He would grant that, as was too often notoriously the case, the bulk of that reward had been reaped, not by the inventors, who conferred the benefit, but by the enterprising company who worked the inventions, and to whom for their enterprise some degree of credit was unquestionably due; but he would firmly maintain that the benefits conferred upon the public had been immeasurably greater that those conferred upon the inventors and their co-adjutors, and that, in the true spirit and interest of the Patent Law, the contract entered into by the crown on behalf of the public, by which, in return for the invention, the crown granted a patent right for the limited period of fourteen years, was a just and beneficial conract.

Mr. J. A. MACFIE said he felt very much honoured and gratified in having the opportunity of being present and listening to the discussion, and he was only sorry that the cause which he espoused had so few advocates in a place where, above all, he should have thought that it would have found friends to support it. He was glad that the Hon. Secretary of the Association for Promoting Social Science had addressed the meeting so well and so ably, and he was afraid that in having to follow him he should prove the great advantage of professional men over plain men of business. The subject was a very large one, and had been most ably brought before their notice by Mr. Webster, whose paper embraced questions which had been very often debated—namely, right of property in inventions, what reward ought to be given to men of genius and men of skill who benefited the public by their inventions, the present state of patent law in Britain, and the best remedies for the evils which were universally admitted to exist. These subjects could not be considered without also taking into consideration the state of affairs with regard to inventions in other countries with which England stood in relation, and the changes which had come over British commerce and British manufactures by the introduction of free trade. The principle which had been advocated by many in this Society, when reduced to different language, was, that every man who made an invention had a right to prevent others from doing what he had done. That was, in plain terms, the proposition which they were asked to receive. Without going very far into the subject, he would only remark that it was very fortunate for us that we did not live in the days of Adam and his immediate descendants, for then everything was new and everything was an invention, and our race would still have been savages. He could not think that anything which would not apply to such a state of society could be consistent with the Divine law, and since he took such high ground as that, they would allow him to say that he thought that many of the things which were said on this subject were hardly consistent with the principles of the religion which prevailed in this country. Those who doubted the advisability of this system of rewarding inventors by means of monopolies were not averse to any amount of honours. One of the speakers had rather disparaged honours, but he could say for himself that he would rather have some honour, some acknowledgment from the Queen, some proof that he had served his country, than he would receive a thousand pounds; and he was quite sure that there were many who were influenced by the same feelings. But although they heaped honours on those who really deserved them, yet he was sorry to say that one of the defects of the present system

was, that it was no honour to be a patentee, for they were only a class of persons many of whom pretended to be inventors without having done anything at all meritorious or deserving of the privileges which they enjoyed. With regard to the question of property in inventions, he would offer one or two observations to show that, in the ordinarily accepted sense, this could not exist. What was bought was not the invention, but the secret. The patent was the recompense, not for the invention, but for the secret, and the proof of that was that a reward was given to any man who imported an invention, and in that case the reward was not for an invention, but for having communicated to the country a secret; therefore the property was not in the invention, but in the secret. Canada, acting on this principle, had stipulated that she would give no patent but to those who were resident within her own territories. He only gave this as a proof that, even in our own colonies, where they had got emancipated from the old traditions of our country, they actually acted upon the principle that there was no inherent or natural property in inventions. It occurred to him, however, that our friends on the other side of the Atlantic would show a little more good sense if they would consider the public interest rather more even than that of those favoured few who made inventions. In point of fact, in their way, they did consider the public, because their practice simply amounted to this, that they presented gratuitously to the colonies of Great Britain the produce of all the inventions which we pay for, and thereby hung a thought which required great attention in these times, namely, that the people of Great Britain were throwing upon the manufacturers of Great Britain the great burden of patents, and at the same time, as Mr. Hawes had very properly stated, they were calling upon them to compete, under free trade, with all countries in the markets of the world, and with those who were using our inventions without paying for them, while our manufacturers were obliged to pay the heavy royalties which patentees demanded. What had to be considered was, the best means of getting rid of these heavy burdens, which would prevent Britain from running successfully in the race of commerce. Another proof that there was no natural property in invention was afforded by our own law, because if there really was any property in an invention, it would go to a man's heirs and successors, and would not go from him at the end of the fourteen years; this, however, was not the case, and it plainly showed that this was not what we called "property." Again, another excellent suggestion had been made by Mr. Webster, and was entitled to all the weight which anything coming from him deserved, and that was that there ought to be the privilege of a compulsory sale, which could not, of course, exist in the case of property. The second proposition of our patent laws, when reduced into shape, was that every man who found out a new way of doing a thing, must first undertake a very heavy task. Before a man could use his own invention he must do what would be the work of a lifetime, namely, inquire whether anybody else had the plan patented. If he made any discovery, he must first of all, before he could do anything with it, go to the patent office, and to all the various manufacturers who used the particular machine in connection with which he had made his discovery, and ask them if they had ever seen his way of doing it before. Surely this was a most preposterous state of things! He said it deliberately, that if he was a patentee he must either neglect his business to attend to his patent, or else he must neglect his patent. What he held was, that if a man was a patentee he must go to all parties connected with his trade, and tell them what his plans were, and make arrangements with them. Another hardship was for a man to find himself duped after he had made his arrangements with a patentee; but he was sorry to say that the present laws enabled persons to be victimised in that way. Above all, it must never be forgotten that times were changed, and that we were changed too, and that we were not consistent in maintaining patent laws, which only tended to restrain trade.

Admiral Sir EDWARD BELCHER said the question of absolute invention, of the strain on the brain in bringing the first idea into satisfactory action, could only be comprehended by those men who had toiled, and dreamed, and expended time and money, in perfecting an invention. Inventions which deserved the protection of patents should only be discussed by actual inventors. If it were assumed that the great men who had risen to eminence in their different pursuits, saw no bright light ahead which was destined to reward them for their labours, it was most probable that, counting the cost, the waste of time, and the ungenerous return which inventors experience from the public, they would at once exclaim, "Better far stick to my work with the tools I have than fool away my time that others may benefit by my exertions." Inventions, however, in many instances, were not the result of absolute study for a decided purpose; in some cases the result of mere accident. An instance of this had occurred to him without the slightest idea of seeking for or taking advantage of it. He was engaged in turning a very hard wood, which threw off very fine bright sulphur-coloured shavings and dust, and had invited a party to dine on board his ship. His steward warned him he had barely time to dress, and brought him hot water. It was near the equator, and the exertion of turning had produced profuse perspiration. He washed his face with the plain water and got rid of the fine dust. The moment he begun to use the soap to his hands and nails they were immediately dyed of a bright red, and in that state he was compelled to receive his guests. That, however, was his secret: he had, *malgré lui*, discovered a dye. Now what was the effect of a discovery made under such circumstances? For the moment he followed it up, amused himself by dyeing flannel, cloth, &c., but his time was too valuable; he had other duties demanding his attention; it would not pay, and it passed unnoticed. So would it be with engineers and workmen—unless they saw the course open, by the protection afforded by patent, they would in a similar manner neglect discoveries of the utmost importance.

Mr. GEORGE CLARKE said, that when in a discussion of this kind men of such distinction as Mr. Hawes, the Chairman of the Council, Sir William Armstrong, and others who had evinced the highest talent and the soundest discrimination, expressed the views which they had, it became the duty of inventors and of the public, whose interests were really identical, to stand up in favour of protection to inventors. There had even been some hints in the legislature as to an intention to abolish the patent laws, and he thought it was, therefore, incumbent upon inventors to do their best to refute the hollow arguments by which it had been attempted to be shown that inventions should not have protection. Mr. Hawes said that protection by patents was detrimental to our own manufacturers, because it held out a premium to manufacturers abroad to reproduce our best productions. He confessed that he had read that observation with surprise, and he could not even now quite understand it. It was supposed that from a specification foreigners could at once seize all the ideas of an original inventor, and be able to carry his plans out. Unless that was the view taken, where was the danger to the interest of the country in publishing specifications? They all knew, however, the extreme difficulty of carrying out inventions. It was not always the original inventor who carried out the invention, but it was by the combination of his talents and the capital of others, which he was able to command by having secured a monopoly, that at last the public was presented with all the fruits of the invention. Surely the original inventor had the best chance of bringing his invention to bear, and he certainly thought that the danger to this country was very little of its trade being injured by foreigners taking up our new inventions. But now that free trade existed, supposing the result to ensue which was stated in the arguments of those who stood up for the public, then it would be to the benefit of the public if the foreign manufacturer should be more successful than the original inventor in carrying the invention into practice. They all knew how difficult it was to seize the ideas of others from any written description. It was almost impossible to understand an invention without diagrams and drawings. He knew a case in his own experience in which, in order to introduce spinning machinery into Belgium, although the drawings and specifications were published, the foreigners were obliged to send a skilful workman over to England to engage himself in the manufactory. He saw no reason, therefore, on that ground why patents should not be granted for inventions. Another point which had been referred to was the great number of patents which had been taken out, and the great loss, as it had been said, to the public. This fact, which had been put forward so prominently as an argument against the patent laws, and a condemnation of inventors, was, in his opinion, the highest proof of the great utility of protection, even in the shape in which the law now afforded it. He would not now enter into the present state of the law, which he admitted to be very defective, but what he was advocating was the existence of protection to inventors. It was nothing but the patent law which had brought forth this great number of patents. It was the hope of reward which had stimulated inventors, and which had induced men to become inventors when otherwise they would not have been so. That which happened in all other cases happened in this case; for after all, the shape which a patent took was that of a commercial enterprise, and nothing more. They must evoke the spirit of competition, and if they did that then they would at once obtain those results which had raised this country to the pinnacle of greatness. The great merit of the existing patent law was that it stimulated inventors to compete for the great prizes which were only the rewards of success. They all knew, when they started in the race, that they could not all be successful, but this was the case in all professions and occupations. Therefore, this argument, which was used against protection to inventors, was really the strongest argument in its favour, for it was quite a mistake to suppose that the number of applications for patents represented the same number of real inventions. The number of patents worked in this country, in proportion to the population, was less than in Prussia. He had just been told that the number of patents granted there was only seventy per annum; but the system there was very exclusive, and the committee of experts refused any patent which they did not understand, and, therefore, the number was very much reduced.

(To be continued.)

LAW INTELLIGENCE.

NEWALL v. ELLIOT AND OTHERS.—This was an action brought by the plaintiff to recover damages for the infringement of a patent obtained for improvements in apparatus employed in laying down submarine electric telegraph wires. The improvements consisted—first, in coiling the wire or cable round a cone; secondly, the supports placed cylindrically outside the coil round the cone; and lastly, the use of rings in combination with the cone. At the trial, which took place at the sittings after Hilary Term, the jury found a verdict for the plaintiff. Mr. Montagu Chambers obtained a rule last term, calling upon the plaintiff to show cause why the verdict should not be set aside and entered for the defendants, on the ground that the verdict was against the evidence, and a misdirection on the part of the learned judge.—Mr. Grove, Q.C., the Hon. George Denman, Q.C., Mr. Quain, and Mr. Markly showed cause.—Mr. Montagu Chambers, Q.C., Mr. Cleasby, Q.C., and Mr. Bidder supported the rule, but had not concluded their arguments, which have occupied several days.

TELEGRAPHIC NEWS.

THE TELEGRAPH BETWEEN MARSALA AND TUNIS.—It is reported that the Italian Government intend to lay a telegraph cable between Marsala and Tunis, which will place Malta in direct communication with Algeria.

THE LIABILITY OF TELEGRAPH COMPANIES.—The Court of Common Pleas in St. Louis, U.S., has recently decided that telegraph companies are responsible for any loss or damage occasioned by the incorrect transmission of messages.

PRUSSIAN TELEGRAPHS.—At the central telegraph station of Berlin no fewer than 126 wires are employed. The number of messages sent daily vary from 6,000 to 7,000. The telegrams which pass through Berlin are not included in the above numbers.

COMMUNICATION WITH AMERICA.—It appears that a convention has been signed between the French, Portuguese, Italian, Brazilian, and Haytian Governments, for the establishment of telegraphic communication between the continent of Europe and America. A total subvention of £480,000 will be given jointly by these governments, who guarantee the neutrality of the line.

PORTABLE TELEGRAPH.—A new telegraph has been adopted by the Americans for army operations. The current is magneto-electric, generated by turning a small crank. Neither battery nor acids are required, the apparatus is compact and convenient, and may be carried in a soldier's haversack. We hope to be able to publish a description of this ingenious contrivance shortly.

EUROPE AND AMERICA.—In the recent message of the President of the United States to Congress we find the following important allusion to the opening up of telegraphic communication between America and Europe:—"Satisfactory arrangements have been made with the Emperor of Russia whereby an uninterrupted line of telegraph will be laid between that empire and the Pacific coast. I recommend to your consideration the establishment of an international telegraph to traverse the depths of the Atlantic Ocean, and also the necessity which has arisen for telegraphic communication between the capital and national forts on the coast and borders of the Gulf of Mexico.

BALATA.—At a recent meeting of the Polytechnic Association of the American Institute, the president read his usual summary of the scientific and industrial news of the season, from which we select the following item:—The valata tree, growing in Guinea, yields a juice which is used by the natives instead of milk in coffee. M. Serres states that this juice is capable of being worked into a product much more flexible than gutta-percha, and in every way superior to it.—Dr. Parmelee: Mr. Chairman, I have had eight samples of valata submitted to me for examination. I have as yet investigated its physical properties only. It is not softened by immersion in hot water, it can be vulcanised, and seems to be intermediate between gutta-percha and india-rubber. I understand that it can be procured in large quantities.

AMUSEMENTS OF TELEGRAPH CLERKS IN INDIA.—A correspondent of the *Times of India* communicates the following from a private letter received by him, dated Jubbulpore, 11th April last:—"It appears that a telegraph employé at the Rewah station fired at and wounded a Brahminee bull in that city. The townspeople became infuriated, and, armed with matchlocks, swords, and stones, they rushed to the telegraph bungalow, which they eventually surrounded, threatening the telegraphers with their lives; and in this jeopardy they kept them for several hours, ere the mob could be reasoned into reconciliation. The affair did not go far enough to partake of a political character, but the cause was sufficient to have ended in more mischief than it did; and if some substantial check on such frolics in a native state be not effected, we may some day learn that the whole of the local staff of the telegraph department has been butchered at some isolated Mofussil post, through the indiscretion of some lad. Since the receipt of the above letter I have been informed that on the occurrence of the disturbance the head signaller at Rewah utilised the wire instantaneously, by informing the chief commissioner of the circumstance, whom it threw sufficiently off his equilibrium to cause the commanding officers of all the large military stations within his jurisdiction to be put on the *qui vive.*"

DESTRUCTIVE FIRE AT SILVERTOWN.—On Thursday morning a very serious conflagration occurred on the premises of the Silver's India-rubber and Telegraph Cable Company, situate on the banks of the Thames, and nearly opposite the Royal Dockyard at Woolwich. The buildings cover several acres of land. The adjoining village of Silvertown is wholly inhabited by people employed at the factory. The fire broke out in a timber built manufactory, 250 feet long and 30 to 40 feet deep. It contained machinery for dressing solution, and dressing departments, with drying and spreading shops, armoury, and boiler-house, all of which were severely damaged. In the armoury, which was destroyed, were deposited the rifles of the Silvertown Rifle Corps. The company has issued the following notice:—"We have the satisfaction to inform you that the fire which occurred at our works on Thursday morning will very slightly, if at all, interfere with the execution of orders for our general manufactures." The premises were fully insured.

THE following important letter appeared in the *Times* of the 23rd inst.:—The Persian Gulf Telegraph.—Sir,—The paragraph under this head which appeared in the *Times* of the 19th inst. having given rise to the impression that an interruption had taken place in the working of the line since its completion, I beg to state that the paragraph, which was taken from an Indian paper, had reference to a temporary accident which occurred to the cable while it was being submerged, in the month of March last, and which was immediately rectified. Subsequent advices received from Lieut.-Colonel Patrick Stewart, C.B., have assured us of the continued well-working of the line through the whole length. The messages of the Government are now transmitted twice a-week, each way, between Constantinople and India, by means of steamers on the Tigris.—I am, sir, your obedient servant, LATIMER CLARK.—London, May 21.

SWISS TELEGRAPHS.—During the past few days the following paragraph has been going the round of French newspapers, and is considered by our neighbours across the water as a reflection upon the administration of M. Fould, their Finance Minister:—This year, for the first time since Switzerland was constituted into a political confederation, the Helvetic Budget showed a deficit. This unheard-of fact caused a considerable sensation in the twenty-two cantons. The Federal Council became disquieted, and extreme measures were taken to get rid of what the fellow-countrymen of William Tell considered a scandal. The means resorted to were very simple, merely consisting of an increase in tolls on bridges and on telegraphs, but the honour of the country is considered safe, as the year will pass without a deficit.

MISCELLANEA.

TELEGRAPH LITERATURE.—The literature of the telegraph has recently been increased by the publication of some ingenious tables and pamphlets, by the Count de Lauture. As the titles of these publications will possess a certain value to those persons interested in the transmission of secret intelligence, we subjoin them: "Grammaire du Télégraphie; Histoire et Lois du Langage; Hypothèse d'une Langue Analytique et Méthodique; Grammaire Analytique Universelle des Lignaux." "Short Explanation of the Sketch of the Analytic Universal Nautical Code of Signals." "Analytic Universal Telegraphy; an International Telegraphic Language, simple, accurate, and three times shorter than the system at present in use, presenting in its practice neither the difficulties nor inconveniences of other ciphers." "Sketch of Tables for the Analytic Universal Telegraphy, composed on the supposition of Morse's instruments and signals being used." "On the Telegraphic Transcription of Chinese Characters; a Table with Four Elementary Signals." It is asserted that, with these tables of one square foot, the 40,000 or 50,000 characters and words of the Chinese are transmitted by telegraph with the utmost accuracy, and with one-third of the signals which the same message would require in any other language, or by any other method. The Count's system of telegraphic communication for the army is said to be exceedingly ingenious.

PERSPICUOUS MESSAGES.—The value of speedy telegraphic communication is often alluded to, and justly appreciated in this go-ahead age, but the rapidity, though marvellous, is as nothing when compared with the wonderful *correctness* with which messages are forwarded. As an instance of this, we have much pleasure in quoting the following telegram *verbatim*, as it was received by a gentleman from his friends in Liverpool:—"Macinosh ovfsshelmed vitto eval vants, badly to be relieved con yeu find room for amat Malta il vernels non at Gibraltar can de inducen to go thert. Telegraph immediately."—*Malta Observer.*

ON THE PURIFICATION OF SULPHURIC ACID.—The best means of obtaining sulphuric acid entirely free from arsenic fully bear out the fact recorded by MM. Bussy and Buiguet—viz., that arsenic, in order to pass during distillation, must be present in the state of arsenious acid. I have, however, been led to employ a different mode of purification, chiefly with a view to ensuring the complete absence of all nitrous products, and obtaining a pure acid from the very first, and of thereby obviating the necessity of changing the receiver—a most dangerous operation when distilling sulphuric acid. If the acid contains nitrous compounds, I heat it in a porcelain capsule to a temperature of about 110° C., with a small portion of oxalic acid, till the latter is decomposed, and all effervescence has ceased; about ¼ or ½ per cent. is amply sufficient for nearly all samples of commercial acid. It is best to add the oxalic acid before heating, and to stir constantly till

the reaction is completed. I now allow the acid to cool down to about 100°, and to add to it a solution of bichromate of potassa in sulphuric acid, or some of the salt itself in fine powder, until the pure green colour at first produced by the formation of sesqui-oxide of chromium is replaced by a yellowish green, indicating an admixture of chromic acid in the free state. The acid so prepared, being now distilled, passes from the first perfectly free from all impurity. The addition of the bichromate has another advantage—viz., that if it be first of all applied to a small sample of the commercial acid, it indicates the presence of free sulphurous acid, as well as of arsenious acid, and either of these being present, we may presume on the absence of nitrous compounds. No doubt permanganates would answer equally well; but the bichromate of potassa, which is cheap and easily procured, is so convenient and inexpensive as to leave nothing to be desired.—*F. Maxwell Lyte.*

ARTIFICIAL RAINBOW.—The *Cosmos* speaks highly of M. Duboscq's contrivance for imitating a rainbow, in a French theatre. He employs an electric light, made by 100 Bunsen elements. Its rays are transmitted in a parallel direction by means of a lens through a slot in the form of an arc, to a double convex lens of very short focus, from which the rays pass to a prism, and emerge with sufficient divergence to make an effective rainbow, during the ordinary illumination of the stage, on a screen 18 or 20 feet distant.

CURIOUS ELECTRICAL PHENOMENA.—Professor Tyndall publishes the following account of some curious electrical phenomena observed by Mr. R. Watson, and a party of tourists, in ascending a portion of the Jungfrau Mountain in Switzerland. Mr. Watson, in a letter to Professor Tyndall, says:—"On the 10th of July, 1863, I visited, with a party of three and two guides, the Col de la Jungfrau. The early morning was bright, and gave promise of a fine day, but as we approached the Col, clouds settled down upon it, and on reaching it, we encountered so severe a storm of wind, snow, and hail, that we were unable to stay more than a few minutes. As we descended, the snow continued to fall so densely that we lost our way, and for some time we were wandering up the Lotsch Sattel. We had hardly discovered our mistake when a loud peal of thunder was heard, and shortly after I observed that a strange singing sound, like that of a kettle, was issuing from my alpenstock. We halted, and finding that all the axes and stocks emitted the same sound, stuck them into the snow. The guide from the hotel now pulled off his cap, shouting that his head burned; and his head was seen to have a similar appearance to that which it would have presented had he been on an insulated stool, under a powerful electric machine. We all of us experienced the sensation of pricking or burning in some part of the body, more especially in the head and face, my hair also standing on end in an uncomfortable but very amusing manner. The snow gave out a hissing as though a heavy shower of hail were falling; the veil on the 'wide-awake' of one of the party stood upright in the air, and on waving our hands the singing sound issued largely from the fingers. Whenever a peal of thunder was heard the phenomena ceased, to be resumed before the echoes had died away. At these times we felt shocks, more or less violent, in those portions of the body which were most affected. By one of these my right arm was paralyzed so completely, that I could neither use nor raise it for several minutes, and I suffered much pain in it at the shoulder-joint for several hours. At half-past twelve the clouds began to pass away, and the phenomena finally ceased, having lasted twenty-five minutes. We saw no lightning, and were puzzled at first as to whether we should be afraid or amused."

ELECTRICITY OF THE BLOOD.—At a recent meeting of the Paris Academy, Dr. Scoutetten returned to the important question of the electricity of the blood, and gave a historical sketch of the observations which have been made in the endeavour to prove, by an experiment which leaves no room for doubt, the electricity of the blood, and so arrive at the measurement of its electro-motive force. A large vase of porcelain, with a wide opening, and capable of holding a litre and a-half, was half filled with venous blood; in the midst of this was placed a porous vessel containing 400 grammes of arterial blood; two other small porous vases, of a capacity of sixty cubic centimètres, contained a solution of sulphate of zinc; these two vases were placed at the same time in the two sorts of blood. The zinc electrodes were placed in the solutions, and did not touch the blood. As soon as the electrodes, which were previously attached to the galvanometer by brass wires, were inserted in the liquid, the current was established. The experiments were made on the 29th of October, in presence of chemists, physicians, and distinguished *savans*. The blood was taken from a very old horse, in good health, which was to be slaughtered in the course of the day. The arterial blood came from the right carotid at the same time that the venous blood was taken from the left jugular vein; the porous vessel containing the arterial blood was then placed in the venous blood, and the whole appartus surrounded by a temperature of 40° centigrade, in order to prevent coagulation. The small porous vessels, containing the solution of sulphate of zinc, were sunk up to two-thirds of their height in the two sorts of blood. The amalgamated zinc electrodes were inserted lightly and simultaneously; the current manifested itself by the influence of the needle; it indicated, as in the first experiments of M. Scoutetten, that the positive current travelled from the arterial to the venous blood across the galvanometer. After having reached the stop, the needle oscillated and became fixed at 66°, where it remained for an hour. The galvanometer employed was Nobili's, with a coil of 10,000 turns. To measure the electro-motive force of blood, M. Scoutetten has had recourse, in this second series of experiments, to the method of opposition proposed by M. Poggendorff, and so ably carried out by M. Jules Regnauld. On placing the coupling wire of the two small porous vases in opposition to a normal wire at a constant current, he saw at first that the current became reversed, and hence he concluded that the force produced by the reaction of the two sorts of blood is comprised between zero and 4·50. Proceeding thence to more exact results, he arrived at last at the discovery that the electro-motive force sought was 1·82, that of Daniell's battery being 58; 100 representing the electro-motive power of pure zinc.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1242. J. Hamilton, jun., improvements in electric telegraph posts.

NOTICES TO PROCEED.

833. W. E. Newton, improvements in electric or telegraphic conductors.

PROVISIONAL PATENTS.

1071. G. Schaut, an improved mode of transmitting currents of electricity.

1126. W. T. Henley, improvements in telegraph wires and cables, and in apparatus used in their manufacture, parts of which improvements are applicable to other useful purposes.

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100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	99 to 102	—
100	Submarine Telegraph, scrip. .	all	48 to 53	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	8	1¼ to ¾ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

A report of the entertainment given by the Electric and International Dramatic Club will appear in our next.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; Messrs. DAWSON & Co., Cannon-street, E.C.; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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TO ADVERTISERS.

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THE TELEGRAPHIC JOURNAL.

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PROFESSOR MORSE AND SUBMARINE TELEGRAPHY.

It not unfrequently happens that when a given scientific problem is to be solved, a theory developed by the exercise of the inductive faculties to be demonstrated by observation, or a mechanical difficulty to be overcome, the hope of honour or—what is less valued but more useful—pecuniary reward, will stimulate the genius of our race to labour in the direction indicated, and success is attained by independent workers at or about the same time. History furnishes us with many instances corroborative of this view. It is a moot point as to whether Trevethick or Stephenson are most entitled to the credit of having inaugurated the railway system of the world; M. Le Verrier and Mr. Adams both claim the discovery of the planet Neptune; and until within the past few years it was difficult to decide anent Mr. W. F. Cooke and Professor Wheatstone, whose several claims to the invention of the electric telegraph were contemporary. When disputes of this nature arise, it is very hard to discriminate between the respective claimants; and in adjudicating upon a case, it is almost impossible to avoid giving cause for dissatisfaction to one of the parties to the issue, however impartial the award. In the matter to which we are about to refer we shall not seek to conciliate individuals, but rather to elucidate facts with regard to one of the most important inventions of modern times.

In a letter which appeared in our last, Professor Morse denies to the late Mr. J. W. Brett the title of "father of submarine telegraphy," and claims "to have *first proposed* and personally laid and operated the first submarine telegraph" himself. The question as to who originated the system of subaqueous telegraphs may now be considered to be in dispute, and we shall shortly lay before our readers evidence which may not tend to corroborate our reporter's incidental remark, to which our attention has been directed, but which unmistakeably deprives the American professor's claims of all weight and importance. The most remote allusion to submarine telegraphy to which Professor Morse refers us is contained in a letter of his to the Hon. Levi Woodbury, Secretary of the United States Treasury, dated New York, 27th September, 1837, "on the propriety of establishing a system of telegraphs for the United States." In this document, after entering into a variety of estimates as to the probable cost of construction of an aerial line of telegraph, &c., the writer says:—"This mode would be as cheap probably as any other, unless the laying of the circuit in water should be found to be most eligible. A series of experiments to ascertain the practicability of this mode I am about to commence with Professor Gale, of our University, a gentleman of great science, and to whose assistance in many of my late experiments I am greatly indebted." Thus it will be seen that at the date of this letter Professor Morse had but conceived or obtained the idea of submarine telegraphy, and proposed to himself some inquiries as to its feasibility.

We will proceed with our narrative, bearing in mind one or two little but important facts—viz., that the telegraph at this time was but in its infancy; that the press of England readily trumpeted forth every incident of interest connected with the then, as now, wonderful science, and reported from time to time every experiment made or to be made by either Mr. Cooke or Professor Wheatstone; that America is but three weeks' voyage from England; and that at this date Professor Morse had introduced the subject of telegraphy to the Government of the United States.

In the month of March, 1837, Mr. Cooke and Professor Wheatstone had made arrangements for an experiment to test the practicability of telegraphing through a cable submerged in the river Thames between Somerset House and Mr. Walker's shot tower, in the vicinity of Waterloo-bridge, and the following letter, showing the progress of the work at that period, will be perused with interest:—

"Greenwich Ropery, 10th June, 1837.

"Sir,—We have proceeded with the operation of covering the copper wire with hemp, but previous to forming it into rope, we should be glad to submit it to your inspection and approval; and if you can make it convenient to come down here, we should feel obliged by your suggesting such alterations as may appear to you advisable.

"We are, &c.,

"— Cooke, Esq. (Signed) Enderby Brothers."

This rope or cable was first tried on the London and Birmingham Railway, under the direction of Mr. Cooke; while it remained there a heavy shower of rain wetted it through, and destroyed the insulation of the wires, and made it evident that some better plan of insulating the wires would have to be devised before success in submarine telegraphy could be attained. The project in contemplation was accordingly abandoned; and it was this fortunate accident that saved the parties the mortification which would doubtless have followed the ridicule and failure of the much-talked-of Thames experiment. Later in the same year Professor Wheatstone proposed another scheme, in which he intended to employ some earthenware tubes, which he had made for protecting the conductors from the influence of water; but Mr. Cooke dissuaded him from attempting it, representing to him that even if the porous character of the tubes could be obviated, their extreme fragibility would occasion frequent *contretemps*. These facts in themselves would be a sufficient answer to Professor Morse, but we have a yet more striking refutation of his assumptions.

Before the subject of submarine telegraphy had attracted any degree of attention in England, Dr. Sommering, of Munich, and Baron Schilling, of St. Petersburg, had not only proposed, but had actually conducted a series of experiments in the Russian rivers, before credible witnesses, to which Dr. Hamel, in his "Historical Account of the Introduction of the Galvanic and Electro-Magnetic Telegraph into England," thus refers:—"On the 12th of June, 1811, Sommering made some experiments to telegraph through water, first across a canal on the river Isar, and afterwards along the river itself." Some doubt has been expressed as to whether this evidence is admissible in the consideration of the question at issue, as it is most probable that Sommering simply employed the water as a conductor without metallic agency, as Mr. Haworth and others have done in later days, but without any practical results. We will not contend whether this can be considered a feature of submarine telegraphy, but will pass on to a very conclusive revelation made by the same author:—"In 1812, Baron Schilling [who was on intimate terms with Dr. Sommering] conducted some operations with a *subaqueous* galvanic conducting cord across the river Neva, at St. Petersburg." Schilling afterwards, in 1837, ordered a submarine cable to be made to unite Cronstadt with the capital, through the Gulf of Finland, for telegraphic correspondence.

From the foregoing it will be seen that Sommering, Schil-

ling, Cooke, and Wheatstone each proposed submarine telegraphy some time before Professor Morse dates his claim; and that the latter thought or knew anything of this branch of telegraphy prior to the announcement in America of Cooke and Wheatstone's contemplated Thames experiment, is not borne out by one iota of evidence. Professor Morse has been eminently successful in having introduced the telegraph into the United States from this country, and has been handsomely rewarded for his 'cuteness. He espoused the art of telegraphy in its early days, promptly availed himself of every improvement made known in Europe, and with the assistance of an able chemist in Dr. Gale, and a skilful mechanician in Mr. A. Vial, he was enabled to perfect the transmitting instrument which now bears his name. Beyond this he has no title to consideration with Sommering, Schilling, Weber, Gauss, Steinheil, Cooke, and Wheatstone.

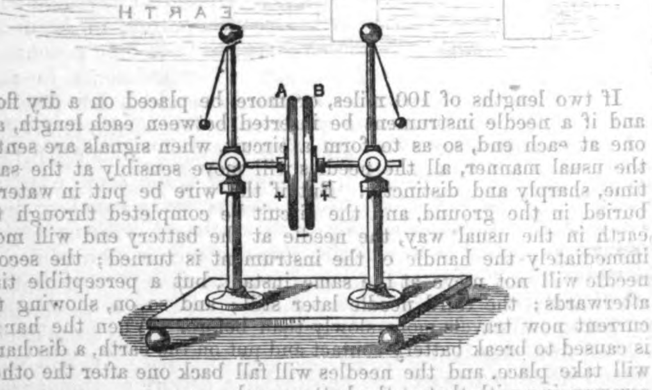
INDUCTION.

WE this week place before our readers an interesting extract from the instructive and valuable work of Mr. R. S. Culley, which was reviewed in the early numbers of this journal. The subject is one but little understood, even by our most advanced electricians. Mr. Culley has explained it in a clear and intelligible language, so that our non-scientific readers will have no difficulty in following the author in his description of the phenomenon of Induction.

In addition to the power of communicating a *charge* by spark or contact, an electrified body exerts a peculiar influence on all conducting bodies near it, which increases if they are made to approach, and diminishes if they are removed to a greater distance, nearly ceasing after a certain limit of distance has been attained. This influence on conductors not in contact is called *Induction*.

When an electrified body is brought sufficiently near an insulated unelectrified conductor, the natural electricity of the latter is decomposed, the electricity of the *same* name (positive or negative) being repelled, and that of the opposite name being attracted; so that, however thin the body may be, even if it be a piece of gold leaf, its opposite sides will have contrary tensions. The induction, strictly speaking, does not take place on the conductor, but on the adjacent surface of the air, or the dielectric which coats or covers the conductor.

Take two insulated plates of metal, A and B, connect each to a separate electroscope; charge A, its electroscope will diverge; bring it near B, taking care that a spark be not allowed to pass



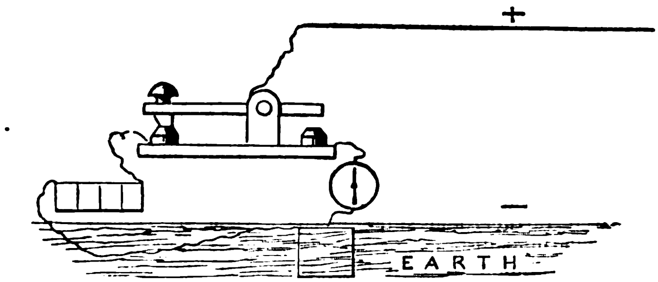
between them, so as to charge B in the ordinary way, the electroscope connected with A will remain divergent, because the plate remains charged, and that of B will diverge, because of the induction exercised upon B by A. Separate the plates, A will remain divergent, but B will cease to show signs of electricity, because the inductive influence of A has ceased. Thus:—if the plate, A, is electrified positively, and made to approach the insulated unelectrified plate, B, its positive electricity decomposes the natural electricity of B, attracting its negative to the side next A, and repelling the positive to the other side of the plate. When A is removed, the two separated electricities of B recombine, and it regains the neutral unelectrified state, while A has neither gained nor lost anything by its action on B. If when the two plates are near each other we touch A, we shall discharge it, and all electrical signs will cease in both plates. If we touch B, instead of A, we shall not discharge A, but we shall remove from B the positive portion of its natural electricity, which has been separated by the influence of A. It will escape to the earth through the finger, leaving B charged negatively. This negative charge will be held fast by the positive charge of A, and will exert no influence on surrounding bodies, so that the electroscope of B will cease to diverge, as if that plate had lost all electrical tension. If we now touch A we shall not discharge it, as we should have done in the first instance, because of the inductive influence of B. In fact, the reaction of the opposite charges in the two plates prevents either being entirely discharged by a single touch, unless both are touched at the same moment. If the plates are removed beyond the distance at which they can sensibly act upon each other, the electroscopes both of B and A will diverge, for the two charges are now free to act on bodies within their influence, and therefore repel their respective pith balls or gold leaves. Either plate can now be readily and perfectly discharged. If they are made to touch, their respective charges will rush together and neutralise each other. If when the plates are very near one another a piece of glass be placed between them, the inductive effect will be greater than when air alone intervenes. A plate of shellac will increase it further, and sulphur will have a still greater effect. Each insulating substance, or *dielectric* as it is called, has a natural power appertaining to itself with respect to induction, which is called its "specific inductive capacity."

A pane of glass coated on both sides with metal foil within an inch of its edge, or a wide-mouthed bottle coated inside and out to within a short distance of its neck, forms a *condenser*. The coated bottle is called a Leyden jar. The foil on the one side may take the place of A, that on the other side the place of B. The condenser is so called because, by its means, we are enabled to condense or accumulate upon a given surface a greater quantity of electricity than it would contain were induction not brought into play. We can also make use of the *specific inductive capacity* of glass, resin, gutta-percha, or other *dielectrics*, still to increase the charge. For as the positively charged plate, A, now represented by the inner coating of the jar, is very near B, represented by the outer coating, the positive electricity of the latter will be repelled, and if B is not insulated from the earth, its positive electricity will escape and the outer and inner coatings will be charged, but with opposite electricities. B reacts on A, so that their respective charges are, as it were, held fast the one by the other. A is then able to receive an additional positive charge from an excited body, which it would not have been able to receive but for the influence of B.

Faraday considers that a current is conducted along a wire by each successive particle undergoing induction, and discharging itself to the next beyond it. The particles of a *conductor* offer very little obstacle to this induction and discharge, so that the current or transfer of force is carried on with extreme rapidity. When the wire is sufficiently near another conductor to be able to exercise an inductive influence upon it, the exterior induction must be completed by each portion of the wire before the current can pass on to the next. This process occupies a sensible time. When the wire is fully charged, it conducts precisely as if there were no induction, so long as the current is steady and regular. If it varies, the induction must be increased or diminished, as the case may be, before the variation can be transferred to the distant end; and when the battery contact is broken, the induction must cease in each successive section of the wire before it is fully discharged. Though induction takes place in curved lines as well as in a direct line, yet it diminishes so rapidly with distance, that the effect is always greatest on surfaces *directly* opposed to one another; thus, though a wire suspended on poles influences the wires near it and the earth, the effect is very slight compared with that of a buried wire. Yet it can be made evident by proper means.

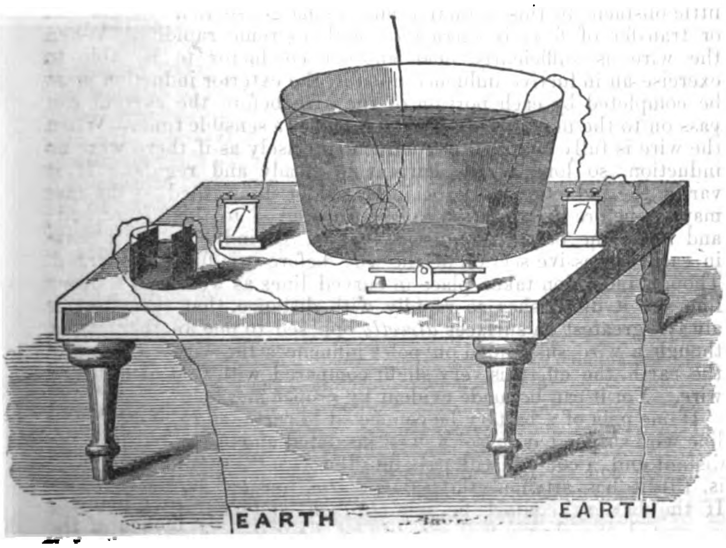
If one pole of a battery be connected to earth, and the other to a line wire suspended on poles, well insulated and *disconnected* at the distant end, a current will pass into the wire till it is charged, that is, till it has attained the same *static* tension as the battery. If the battery contact be now broken, and the wire left disconnected, the charge will speedily be dissipated through the air,

and by leakage at the supports. But immediately battery contact is broken, if the wire be put to earth at the sending end through an electro-magnet or galvanometer, a *discharge* will take place through the apparatus, as when the plates A and B are made to touch one another. If the wire is short, the discharge will be completed before the apparatus has had *time* to move. The time increases with the length of the wire (other things being equal) until it attains sufficient duration to affect the apparatus. For instance:—if the key of a Morse instrument, connected to a long, well-insulated wire, be pressed so as to charge the wire, and be then allowed to fall back very suddenly, the discharge or *return current* will move the relay and produce a signal. When the wire is very long, it is not necessary even that it be disconnected at the distant end, because the resistance is equivalent to partial insulation.



As induction requires time, it tends to limit the rapidity with which signals can be transmitted; for if the effect of one current has not entirely ceased before that of another commences, the signals will "*run together*" and be confused. On half-a-mile of suspended wire 500 or 600 signals may be readily sent per minute; but at a distance of 500 miles the current would appear continuous. By reversing the currents the wire can be discharged more rapidly, and the speed increased. If the line wire were brought very near the ground, the inductive action of the wire and earth would be increased, and the time of discharge increased also; and if it were covered with an insulator and buried, so that the distance were still further decreased, and the wire directly opposed on all sides to another conductor, induction and retardation of signals would be enormously increased, and the discharge or *return current* would be very powerful, because an immense Leyden jar would have been formed, having the wire for its inner and the earth for its outer coating, which being in direct communication with the earth, like the plate, B, when touched with the finger, would part with the electricity set free by induction, enabling the wire to take up an additional charge from the battery. Each mile of ordinary coated copper wire (No. 16) has an inner surface of about 86 square feet, and an outer surface of 330 square feet. A hundred miles of such wire will expose a very large surface.

Mr. L. Clark gives the following illustration in the "Submarine Report," p. 316:—Insulate a large tub filled with water, and place about half-a-mile of percha-covered wire in it. Put one pole of a



battery of 250 cells to earth, connect the other pole through a key and galvanometer to one end of the wire, leaving the other end disconnected and well out of the water. Place a copper plate in the tub, connect it by a wire to a second galvanometer, and put the other terminal of this galvanometer to earth. The water of the tub will thus be put to earth through the second galvanometer. If a charge be sent into the half mile of wire by moving the key, electricity of the same kind will leave the water for the earth. Both the galvanometers will move in the same direction, precisely as if they were both in circuit, whereas the circuit is not completed. There will be this difference:—in the case before us the needles will be affected for an instant only, however long we may press the key, while if the circuit were complete they would continue deflected until battery contact was broken. The water, which is the outer coating of the wire, and which takes the place of the plate B, is put to earth. Hence the portion of its electricity, repelled by the charge given to the wire (or plate A) passes to earth, and an additional quantity passes into the wire from the battery.

If 100 miles of covered wire be placed on a wooden floor, signals may be sent through it nearly as clearly and distinctly as on an ordinary circuit of the same resistance. But if it be put in water, one end insulated, the other end connected through an ordinary needle instrument to earth, and a battery of 40 or 50 cells joined to the instrument, then, if the key be moved as if to send a signal, the needle will be violently deflected for an instant, by the current entering the wire to charge it. As soon as the wire is charged the needle will regain the perpendicular, although the key is still held in the position for sending a current. If the handle be placed upright so as to cut off the battery and put the wire to earth, the needle will again be violently deflected, but in the opposite direction, by the charge escaping from the wire.

Now, if the wire had been lying on the floor instead of in the water, the needle would scarcely have moved, however powerful the battery; for though a current would enter into and charge the wire in this case also, the effect would be slight, and last too short a time to do more than barely move the needle. Similar effects will arise if the wire is connected to earth at the distant end, but they will be less marked.

If two lengths of 100 miles, or more, be placed on a dry floor, and if a needle instrument be inserted between each length, and one at each end, so as to form a circuit, when signals are sent in the usual manner, all the needles will move sensibly at the same time, sharply and distinctly. But if the wire be put in water or buried in the ground, and the circuit be completed through the earth in the usual way, the needle at the battery end will move immediately the handle of the instrument is turned; the second needle will not move at the same instant, but a perceptible time afterwards; the third needle later still; and so on, showing the current now travels more slowly than before. When the handle is caused to break battery contact and put on the earth, a discharge will take place, and the needles will fall back one after the other, commencing with that at the battery end.

The practical effect on a needle circuit is this:—the sending needle is jerked violently in the reverse direction after each signal, and frequently becomes demagnetized, or cross magnetized by the discharge or return current. The receiving needle moves sluggishly, and the signals run together, so that a letter of three movements appears like one of a single movement sent slowly. Signals through buried wires are thus seriously retarded.

On a printing circuit the marks run together, each dot being lengthened by the discharge of the electricity "pent up," as it were, by induction.

Reversing the current facilitates the discharge at the sending end, by neutralizing the charge with electricity of the opposite name, so that there is not so much to escape at the receiving end. This renders the received signals much more distinct.

When a covered wire is coiled into a regularly formed bundle, especially if it be wound upon an iron drum, the discharge at the sending end is in the same direction as the current entering the wire, instead of the opposite direction. By some it is supposed that this is caused by the *induction of a current on itself*, causing a prolongation of the flow of the current in the wire after battery contact is broken. On a short length this is stronger than the "return current," and overpowers it; therefore the return current in a coiled cable *appears* to be in a different direction to that in the same cable when laid out straight. Mr. C. F. Varley considers this to be purely a magneto-electric phenomenon.

In testing a buried wire, or even a well insulated suspended wire, the distance of a disconnection may be estimated by the amount of the return current; for the longer the wire the longer will be the time occupied in the discharge, and the greater its amount. If two or three successive currents be sent into a long buried wire, they will travel on independently of each other. It is even possible to produce alternate waves of positive and negative electricity, that is, to charge the two ends of a wire oppositely.

A cable, coated with iron wire, is subject to a large amount of induction, even when out of the water, because the iron covering is a good conductor. When coiled, the induction of the current on itself is increased by the reaction of the magnetism set up in the iron coating.

A spark may be obtained by making and breaking contact between a battery and an electro-magnet, or even a spiral of wire, when the wire forming them would give no spark if stretched out straight. This increase of effect is due to the same cause as the difference in the direction of the discharge in a coiled cable from that in one laid straight.

As a wire, even when most free from inductive retardation, takes a certain time to charge, the current will not attain its maximum strength till battery contact has lasted sufficiently long. The more faulty the insulation, and the longer the circuit, the more firmly and slowly must the battery contacts be made.

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(*Continued from page* 257.)

9. *Induction Coils.*

Siemens & Halske, Berlin, M. (Prussia, 1,413), exhibit the finest induction coil shown. Every detail connected with it has been made the subject of accurate experiment, and the results obtained are well worthy of attention. They have kindly sent a description, of which the following is a free translation:—

This instrument consists of a core of iron wires, each 1·3 millimetres in diameter, and 95 centimetres long. These are cemented together, and form a cylinder of 60 millimetres in diameter. Two layers of copper wire 2·5 millimetres in diameter are wound round this core; the primary coil and iron core weigh together 35 lbs. They are placed in a tube of hard vulcanized india-rubber (ebonite), which is 26 millimetres thick at the ends, and 12 millimetres in the middle. Along this tube 150 thin discs of ebonite are fastened at equal intervals, and the two ends are covered with thick discs of the same material. Each subdivision between the little discs is filled with a coil of fine silk-covered and varnished copper wire 0·14 millimetres diameter; these coils are so connected as to form one continuous secondary coil, in which the current will run from inside to the outside of one compartment, but from the outside to the inside of the next. By this device no two portions of wire at greatly different potentials are ever in close proximity, and consequently the risk of injury to the coil by its own current is greatly reduced.* The length of the secondary coil is 10,755 metres, and it makes 299,198 turns round the cylinder. The weight of the copper wire is 58 lbs., and its resistance 162,000 of Siemens' mercury units. The resistance of each of the two layers of the primary coil is 32 of the same units.

The insulating tube is made thicker at the ends than at the middle, because the electrical tension is much smaller in the middle, and under normal conditions is even nothing, but gradually increases towards the two ends, so that a disruptive discharge to the iron core is only to be feared towards the end. Another reason is to be found in the fact that the layers of the secondary coil nearest the tube form together with the tube and the primary coil a sort of Leyden jar. The capacity of this Leyden jar should be kept as small as possible, since otherwise the electricity developed by the iron core is held condensed, and the striking distance of the sparks considerably diminished. Now, since in the middle the tension of the secondary wire is null, no unfavourable condensation occurs at that point, and therefore the secondary and primary wires are here brought as near as possible. The best form of the tube is that in which the longitudinal section of its outer surface forms a parabola. Messrs. Siemens use a make-and-break apparatus in connection with this coil, which is set in motion by a barrel-spring; the contacts are made by a platinum point and a platinum or a silver amalgam covered with alcohol. This apparatus is driven quite slowly when long sparks are wanted; the contact is continued for a long time, and very suddenly broken by a small cam which lifts the platinum point.

A spark of from one to two feet in length can be obtained between point and plate with six large Grove's elements. The two layers of the primary coil are used in multiple arc when the number of elements is less than six, and in series when larger than six. This instrument is especially remarkable from the great length of spark obtained with a comparatively very small length of wire in the secondary coil. In fact, this length does not exceed 6¾ miles; whereas other induction coils have required 50 miles to give similar results.

W. Ladd, London, M. (United Kingdom, 2,925), exhibits induction coils, from which he obtains five-inch sparks, using five cells of Grove's battery, with plates five inches by three inches immersed. The construction is as follows:—On a core of iron wire about a foot long are wound fifty yards of copper wire of No. 12 B.W.G. (·034 inches) insulated with cotton; this coil forms three layers, round which five or six thin gutta-percha sheets are wrapped. The secondary coil, formed of three miles of No. 35 copper wire (0·005 inches) insulated with unvarnished silk, is wound backwards and forwards along this core, with each layer insulated from the preceding one by five or six sheets of thin gutta-percha.

Mr. Ladd also shows a coil of very different proportions; the iron core and primary coil are about eight inches long, but the secondary coil placed in the centre of its length is only four inches long, but seven and a half inches in diameter. Much the same results may be obtained with this as with the preceding coil.

Mr. Ladd's "make-and-break" for the coil is very simple, but apparently effective. A soft-iron armature is carried by a spring in front of an electro-magnet. The reaction of the spring can be strengthened or weakened by a set-screw. When the reaction of the spring is weak, the coercive force of the electro-magnet retains the armature for some time after the current ceases, so that some time lapses before it flies back again to make contact, and when contact is made it is immediately broken; when, on the contrary, the spring is strong, the current hardly ceases before it is re-established, and is not again broken until the electro-magnet has reached its full strength. This simple plan allows the number of contacts per minute to be readily regulated, as well as the proportion between the make and break.

As already mentioned, Mr. Ladd exhibits a great variety of vacuum tubes for use in connection with his coils, to demonstrate the various phenomena of the "striated electric discharge" that have been so elaborately investigated by Mr. Gassiot. He also exhibits two apparatus that deserve notice from their singularly beautiful results. One of these, the *electric cascade*, consists of a glass vase placed under the receiver of an air-pump, down to the bottom of which one of the electrodes is carried, the other being connected with the plate of the air-pump. When the plate is negative, the current appears to flow out of the vase in a single stream; but when it is positive, the vase is surrounded by a glow, and if made of glass coloured by uranium, is brilliantly illuminated by fluorescent light. In the other, the discharge is made to pass along the surface of a glass tube in an exhausted receiver. When a cylindrical bar magnet is introduced into the glass tube, and the receiver sufficiently exhausted, a stream of light will be observed to rotate round the magnet.

A. Rasmussen, Copenhagen, H. M. (Denmark, 152), exhibits an induction coil for medical purposes, in which the primary circuit may be made and broken either by the common trembling hammer or by clockwork driven from a barrel spring. By means of the latter, longer or shorter contacts can be made at will.

* Mr. C. F. Varley has shown the writer a description of this method of winding the secondary coil in a patent taken out by Mr. Varley in 1856.

Considerable numbers of induction coils for medical purposes are exhibited; they are generally arranged with considerable ingenuity, with various means of altering the number of shocks per minute, and their strength.

A. Moreau, Paris (France, 1,443), exhibits a large collection of highly-finished induction-coil machines for medical purposes; they do not, however, present any peculiar features of construction that require special notice.

10. *Miscellaneous Philosophical Instruments.*

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit an electric resistance thermometer, in which the change of resistance which metals undergo, with a change of temperature, is made use of to indicate the temperature of the metal. Two perfectly similar coils of insulated wire are enclosed in two hermetically-sealed copper cases. One is placed on the spot of which the temperature is required, and the other in a bath of water; the temperature of the bath is altered until the resistance of the two coils is exactly equal, an equality which can readily be tested by a differential galvanometer. The temperature of the bath will then clearly be equal to that of the spot where the first resistance coil is placed. The connections are made with very thick copper wire, so that their resistance shall have little or no influence on the result. The wires are coiled on an open copper cylinder of considerable diameter and length, so as to expose a large surface to the air or water in which they are placed. They in consequence take the temperature of the surrounding medium with great rapidity. This instrument will be found useful for determining the temperature at different depths in the sea, and other similar purposes. A similar idea was made use of by Svanberg for some experiments published in Poggendorff's Annalen for 1851.

The Telegraphen Werkstätte of Berne (Switzerland, 151) exhibit an "electric self-registering thermometer." This instrument is an application of Bréguet's metallic thermometer. Two metal strips, brass and steel, are soldered together and bent into a spiral, the inner end of which is fastened to a brass standard, while the outer end carries an index with a steel point, used to mark the registering paper. Two brass rollers, one of which is connected with a ratchet-wheel, unroll a wide strip of paper about 130 metres long, and pass it under the steel point. An electro-magnet and armature are used to mark the paper; a momentary voltaic current is sent round the magnet at fixed intervals (every twelve seconds in the Observatory of Berne) by a clock with suitable contacts; a lever fixed to the armature strikes down the end of the index at the moment when the current passes, and so prints a dot on the paper; when the current ceases, a paul fixed to the armature moves the ratchet-wheel one tooth forward, carrying the paper along with it. Two millimetres on the paper are equivalent to one degree centigrade. A little fixed wheel impresses a straight line in the centre of the strip of paper, from which the deviations of the curves formed by the dots can be measured.

M. Hipp, Neufchâtel, M. (Switzerland, 156), exhibits an electric current regulator, intended to maintain a nearly constant current, and designed for use in connection with electric clocks.

The mechanism consists of two electro-magnets, the armature of one of which works the pointers of the clock, while that of the other is used to increase or diminish the resistance of the battery circuit when any variation occurs in the strength of the current. This is done as follows:—A standard clock makes and breaks contact at regular intervals in a circuit containing the battery and two electro-magnets, one of which works the propelment of the secondary clock. The armature of the second has two springs attached to it pulling it away from the magnet. These two springs are so arranged that if the current passing is weaker than it should be, the armature will not move either of the springs; if the current be exactly that required, the attraction of the armature will overcome one of the springs, and the armature will be attracted to a half-way position. If the current be too strong, the armature will be attracted close to the magnet, overcoming the two springs. Now the gearing is so arranged, that an index will be moved round by the wheelwork propelled by the first electro-magnet, when the armature of the second is in its furthest position, but will be left at rest when the armature is in its second position, and will be moved backwards when that armature is in its third position. The index in its motion turns resistances in or out of circuit, according to the direction of its motion, until the current is reduced or increased to its proper strength.

Electric clocks and other instruments of the kind may be worked with greater certainty and economy, and with less superintendence, by the constant current which is thus obtained, than with the usual variable current; the battery also lasts longer; nor is it necessary to begin with an extra strength of battery, allowing for a gradual diminution of strength; a single glance at the index shows the condition of the battery, and warns the superintendent when it must be replaced by a new one.

Elliott Brothers, M. (United Kingdom, 2,897), exhibit some very delicate and sensitive thermo-electric piles, composed of small bars of bismuth and antimony, for use in connection with Melloni's and other apparatus employed in investigations on heat. Their construction, although not novel, is excellent.

V. PRACTICAL APPLICATIONS OF ELECTRICITY OTHER THAN TELEGRAPHIC.

1. *Electric Clocks.*

Electric clocks have not been so extensively adopted as might reasonably have been expected from the excellent examples shown in 1851. Nevertheless, a considerable number are again exhibited, and those which contain any novelty of importance will now be mentioned.

The British and Irish Magnetic Telegraph Company, M. (United Kingdom, 2,864), exhibit Jones' electric clock. Clocks worked by electricity have hitherto either been driven by the galvanic current or regulated by the release of an escapement. In all these plans, if the battery gets out of order, if the communicating wire is broken or badly insulated, or if any of the contacts are defective, the clock stops altogether; and it is probably this very serious defect which has hitherto limited an application of electricity which at first sight appeared to offer very considerable advantages.

Mr. Jones' plan consists in simply checking any irregularity of beat in the pendulum of clocks to be controlled by a current passed from the standard controlling or regulating clock, through coils forming part of their pendulum bobs. Permanent magnets are fixed on one or both sides of the centre of the arcs of vibration of these pendulums, and the current, at the moment of its passage, influences the position of these pendulums relatively to the fixed magnets. If the pendulum approach the extremity of its arc of vibration a little behind time it is accelerated, if a little before time it is retarded. The current sent by the regulating clock may vary in strength within very wide limits, but only a feeble current is absolutely necessary, since the amount of correction required at each beat is in every case very small indeed. The current acts solely as a corrector of errors, and should any of the above-mentioned accidents occur to interrupt it, the controlled clocks will not stop, but will simply keep their own time independently, until the current is again passed. Thus Mr. Jones' method effects all that can be done by the most perfect and delicate systems of electric escapements, and at the same time entirely avoids the risk of failure inseparable from even the best of these plans. Moreover, it requires no accuracy of construction, and might be applied to almost any form of clock. Mr. Jones' clock is specially mentioned with approval in the award of a medal to the British and Irish Magnetic Telegraph Company.

L. C. F. Bréguet, Paris, M. (France, 1,413), also exhibits a plan for the regulation of clocks by electricity, which successfully meets the above-mentioned difficulties, and has many of the same merits as Mr. Jones' invention. M. Bréguet, instead of correcting all his secondary or controlled clocks once a second, or once at every beat of the pendulum, corrects them only once every six or twelve hours, by then bringing the minute hand exactly to the hour point. This is done in the simplest manner by a little train of wheels driven from a barrel spring, and set free by an electro-magnetic detent at the moment of correction; two small cams, one on each side of a projection connected with the minute hand, are turned once round by this train of wheels; if the minute hand be behind its time, one of these cams moves it on; if it be before its time, the other cam moves it back. This method is simple and effective where no extreme accuracy is required between the long intervals of correction. It moreover avoids the difficulty of making good contacts from the pendulum of the standard clock without some injury to its time-keeping qualities, a danger which Mr. Jones' method does not provide for.

The Universal Private Telegraph Company [Professor Wheatstone, Juror] (United Kingdom, 2,978), and W. T. Henley, H. M. (United Kingdom, 2,908), exhibit fine examples of the old form of clock, in which the escapement is worked by currents received at regular intervals from a standard clock.

T. Van Spanje, Tiel, H. M. (Netherlands, 186), exhibits an

electric clock driven by a ratchet propelment worked with intermittent currents passed from a standard clock through suitable electro-magnets. The propelment is peculiar in having a separate star-wheel on the same axis as the ratchet-wheel. The arm which carries the propelling pallets also moves two stops, which, at the end of each oscillation of the pallets, bring the axis to a dead stand by coming against a tooth in the star-wheel.

M. Gloesener, Liége, M. (Belgium, 349), exhibits a clock with an escapement worked by reverse voltaic currents; he appears to have been one of the first to perceive the advantages to be derived from the use of reverse currents, as opposed to single currents separated by an interruption or an earth contact.

J. H. Koosen, Pirna (Saxony, 2,330), exhibits an electric clock, which is not driven or controlled from a standard or primary clock, but is entirely independent, and keeps time without the aid of a pendulum. It consists of an electromotor of simple form and a regulator. The electromotor used to drive the train of wheels does not require special description. The speed is regulated by a centrifugal governor, so arranged as to interrupt the electric circuit in the electromotor whenever the required speed is exceeded. The centrifugal governor is so disposed as to be extremely sensitive to small variations of speed. The force of a spring is made use of, instead of the force of gravitation, to restrain the centrifugal force of the governor balls, and this spring is so adjusted with reference to the rotating mass, that the slightest excess of speed above that required causes a great deviation from the axis.

It will easily be seen that, with a sufficiently powerful current, the wheelwork will be driven at a sensibly uniform speed, for the current will be continually interrupted by the governor, and only admitted into the coils of the driving electro-magnets for just such a fraction of each minute as will keep the governor on the point of breaking contact. It is to be regretted that the instrument exhibited was so much injured in transit that it could not be put to work. One obvious drawback to the system is the oxidation of the contact points by the strong sparks which must continually pass as in a relay.

Several other examples of electric clocks were exhibited in Class XV. by T. Dettmann, London, H.M. (United Kingdom, 3,246); C. G. Gumpel, Brixton, H.M. (United Kingdom, 3,256); W. Morris, Blackheath, H.M. (United Kingdom, 3,285); C. Shepherd, London, H.M. (United Kingdom, 3,307); A. Müller, Lôcle, H.M. (Switzerland, 218).

(To be continued.)

METEOROLOGICAL RECORDS.

Vice-Admiral Fitzroy has recently published the result of his observations for the past year. The report is addressed to the President of the Board of Trade. Although we for the present only quote a notice of the report which appeared in a contemporary, we intend to refer often to the subject matter of the report:—

"During the time that has elapsed since my last report, experience has brought the natural result of improving our recently-acquired knowledge of atmospheric changes, and giving more confidence in drawing conclusions. Demands have increased for cautionary notices of strong winds, such as would affect the smaller and less efficiently provided vessels, or when increased to gales, if not to storms, might delay, injure, or occasion risk even to well-found ships. Not only are such notices sent day by day regularly to Paris for the French coast, but occasionally to Hanover, and to other places near the North Sea, in consequence of special applications made by foreign Governments. Italy is adopting the methods of weather warning originated at our Board of Trade; and no less than twenty-six stations are intended to be formed under the direction of Signor Matteucci, with a committee, at Turin. While adverting thus to forecasts and cautions, it should not be supposed that these new and immediately practical consequences of this Board of Trade branch office have superseded, or in any degree injured, duties intended to be carried on when first the department was organised (in 1854-5), soon after the Brussels Conference of 1853. In ten years an accumulation of valuable log-books, observatory registers, and miscellaneous records has been effected here. Many years must elapse before these stores and those of the Admiralty (at Somerset House) can be so nearly exhausted, that more supplies of facts than those still continually added, as selected ships arrive, may become requisite. Since 1856 all the logs of her Majesty's ships have been kept in an uniform and well-designed manner; while a supply of good instruments has been available for each ship, and directions have been issued to officers by the Admiralty on the subject of observations; therefore, now an immense amount of good records in naval logs, in addition to the remark-books and surveyors' registers sent to the Hydrographic-office, is available in London. A very large body of facts relating to the atmosphere and ocean, valuable in proportion to their number (being alike accurate), are almost ready for publication; but as a few more may yet be advantageously added to each series, I am reluctant to give them the last notes until able to do so more satisfactorily. In my last report I stated how highly the Board of Trade 'fishery' barometers have been valued on the coasts. They are now eighty in all, specially lent under due control and care. It may be more readily estimated mentally than accurately proved to what extent these simple instruments (all reliably made by Messrs. Negretti & Zambra and tested) have already been the means of saving life and property. Explanatory manuals and blank forms for diagrams have been extensively circulated among the coasters and fishermen, who are all now much influenced by, and very thankful for, the benefits of this act of their Government. Many are the local instances of similar beneficence by individuals, especially the Duke of Northumberland, who has placed no less than fourteen barometers.

"By knowing the statical conditions of atmosphere at several places simultaneously, and again similarly after certain intervals of time, comparisons can be made which show causes of fluent (or dynamic) effects, not unlike those of a head of water acting on a stream, though complicated by the peculiarities of air—in some qualities so different from any liquid. Such atmospheric currents are our winds, softly gentle or increasing to a tempest—powerful in places as a discharge from a gigantic air-gun, or a great explosion. Instrumental means and telegraphy now enable such changes to be made known for many places, if not for all localities, within a certain limited circle of climate—about five hundred miles in radius—where land and water are intermixed, but probably a thousand miles over uninterrupted ocean. It may now be asked—What is our actual degree of acquaintance with atmospheric changes and their indications? In answer, I submit that our knowledge is already sufficient for practical purposes, and may be communicated to a fairly-educated and able person. Ability and due preparation are, of course, as indispensable as for other results of study and practice. That we have proved experimentally how winds and weather may be foretold with general accuracy for two days at least in advance, our reports since 1861 have showed—if insufficiently at first, certainly to the satisfaction of a large majority at present. That we are acting on true principles our results leave not a doubt on my mind (and in stating this, I may be pardoned for alluding to unintermitted attention to meteorology, which special avocations, in all oceans and at many places on land, have induced during forty years of observation). But to act judiciously, with sufficient rapidity, on even unerring principles, is and must ever be more or less difficult.

"It has been asked—'If you are absent, who carries on the responsible duties of forecasting, and giving cautionary notices when necessary?' My reply has been to the effect that an assistant is fully acquainted with the subject, and has not only executed these very duties often during the last two years, but has done so generally since last autumn, occasionally relieved by me, to whom he refers at times, though now but seldom. Besides ourselves, there ought to be two or three in training for these special duties—now systematically established. Often a hasty reply, an off-hand opinion, an injudicious or unqualified answer has been given, and incorrectly, without reference to the forecasts elaborately drawn with deliberation—whence a deserved degree of blame has resulted. But such a discrepancy has been caused by individual error, not by a failure of the system."

ON THE PATENT LAWS.

Discussion.

(Continued from page 262.)

Mr. Winkworth said that he had intended to enter, at some length perhaps, into the discussion, but his friend Mr. Hawes, in his admirable speech on Wednesday last, had so fully anticipated any arguments he could have adduced in support of the views they held in common on this subject, that he would content himself with a few words only. Having about ten years since, on the occasion of a paper on the patent laws read by Mr. Webster—distinguished like that with which he had favoured the Society at their last meeting, by acute reasoning, if not by conclusive arguments—taken a rather prominent part in the discussion, he could not reconcile it to himself to be quite silent that evening. Although in the debate to which he referred only one other member besides himself, Mr. Denison, advocated emancipation from the paralysing influence of these laws, it was spread over no less than three meetings. Either, therefore, the arguments they had advanced were very cogent, or those who adopted the views of Mr. Webster, being themselves inventors and too much dazzled by the prizes which they saw dangling before them, were too much interested in the retention of the law to see clearly that the statements they made of the hardships imposed on inventors by these laws, were precisely those which established their utter worthlessness. For his present purpose it was not necessary that he should affirm or deny that invention or discovery, when published, was property, but it must be borne in mind that such publication was voluntary and not compulsory. All that he argued was that in the interest of progress in art, science, and manufactures, even in the interest of humanity itself, these laws ought to be repealed. Since the time alluded to above, other and more important opponents of these laws had entered the field: it was sufficient for his purpose on the present occasion, though there were many

others whom he might name did time permit, to refer to the late eminent engineer, Mr. Brunel, who, in the chair, when Mr. Hawes read a paper on "the Soap Manufacture," eagerly availed himself of the opportunity to confirm Mr. Hawes's complaint of the impediments to improvement which these laws presented at every turn, and to condemn them from dear-bought experience. In fact he denounced them in the most emphatic language, as having been a constant source of annoyance, difficulty, and loss, the full extent of which it would be difficult to exaggerate. In this he (Mr. Winkworth) fully concurred, and nothing had taken place since that time to alter his conviction that these laws were not susceptible of improvement, and so long as any similar enactments, professing as these did to encourage invention, were suffered to continue in operation, the complaints so frequently repeated during this discussion in various forms, would be urged by the sufferers from them. He need scarcely add that the views he had long entertained were confirmed by the discussion, so far as it had gone.

Captain SELWYN, R.N., said, as a member of the Council of the Inventors' Institute, he felt it would not be well if the discussion were allowed to be closed without expressing the opinion of that body. They felt it to be their mission to protect the interests of inventors, and he was there to say distinctly, that although there might be defects in the present system, and although the laws might be very faulty, and the interests of inventors and the public might appear to be antagonistic, this was not really the case. The first question started by Mr. Webster was, whether inventions should be encouraged and inventors rewarded. No one could have attended the discussions which had taken place without seeing that the general sense of the meeting was to affirm this proposition. He did not see the good of having a board of experts, for his experience of boards had taught him that, if parties applied to boards, they were sure not to get anything done as long as there was any possibility of anything being staved off. He did, however, rely on one board, and that was the public. The public was the great body of experts who seldom or never made an error, and who gave a really practical decision on a patent by giving money for it, and in that way the inventor was very fitly and properly rewarded. But few of the inventions which are brought forward would ever be carried out successfully, if the whole energies of one individual were not devoted to that single object. There had been something said about injustice to the public and the manufacturer. The manufacturer was not obliged to buy an invention, and if he bought a patent and found himself taken in, he had no more right to complain than a man had who had bought a horse without a warranty, and then had found it to be unsound. If he acted on his own judgment, without making proper investigation, he must not be surprised if he was duped. He thought they should never pull a brick out of any structure without they had a better one to put in, and in this case that had not been brought before them. Certainly it had not been brought forward at this meeting. He entirely denied the argument which had been used in connection with the copyright law, and he thought that the manufacturers had not spoken of inventors in the way in which they should, because it must be remembered that it was the inventors who had made the manufacturers what they were, and who had made our great nation what it was. But for them, mankind would now be in much the same condition as they were in the time of Adam. No doubt such men as Sir William Armstrong and Mr. Hawes were in positions which rendered them independent of the patent laws, but he could not conceive of any engineer, mechanic, or artizan, wishing to do away with such a stimulus to exertion and improvement.

Professor WANKLYN wished to correct a remark of one of the speakers, who said that patent laws existed throughout the whole of Europe. There was certainly one place where there was no patent law, and that was Switzerland, and, indeed, throughout a great portion of Germany there was virtually no patent law, for everything had to be patented some thirty or forty times before a patent became valid. According to this it would appear that there was at least one part of the civilized world where patent laws were in disrepute. He would just say one word as to why patent laws should be abolished. The justice due to inventors was often insisted upon, but why was it just to reward an inventor? Only as an example of this great principle—that it was just to reward individuals who conferred great benefit upon society, but who reaped no reward themselves. Now, was this practicable? Could we do this? He thought it was utterly impracticable. There were a great many people besides inventors who conferred immense benefits upon society, but who themselves reaped no rewards. If, then, there was no other argument for the law than that general principle, it must fall at once, because if once they admitted it, it would lead them too far. He would give a very common instance as an illustration. Everybody knew now-a-days of the immense improvements which had been made in the production of dyes. Dyes had been produced, as everybody knew, from coal tar. In the production of these dyes about a hundred people had been employed in order that this end might be produced. What did the patent law do? Why, it did not confer any reward upon any of those hundred people, but only just upon the last man, who appeared to put the last stone to the edifice which others had raised. Now was this just? Why should they single him out, and pass over all the others? The system was an unjust one, and he believed there was nothing in this country so unfavourable to science as the patent laws.

The CHAIRMAN said he thought the meeting would agree with him that the subject had now been sufficiently discussed to make it right that he should ask them to do what he was sure it would be very gratifying to them to do, to express their thanks to the author of the paper, who would be afforded an opportunity of making observations in reply to some of the arguments which had been addressed to the various questions raised by his paper. He should like, however, with the permission of the meeting, to make a few observations upon the subject matter of discussion, before he conveyed their thanks to Mr. Webster for the paper which he had read. He thought it was very fortunate that the subject had been introduced by a man who had himself had so much personal experience in the working of the patent law, and who had had a large share in the framing the patent law of 1852, or at least in the combining of two bills into one Act of Parliament and who since that time had had great experience of the working of the Act. He would not, however, consider the merits or demerits of the Act of 1852, which regulated the forms of precedure necessary for acquiring patent rights, but would limit himself to an inqniry into the claims of inventors to some public recognition. With the exception of one or two gentlemen, there had been but little disposition to deny the claims of men who had invented important improvements in manufactures to some kind of recognition. He thought the general objection had been rather to the form of recognition by means of the patent law. If it were fitting to reward intellectual results in the form of inventions, or of works of literature, or art, the question then arose whether the protection of inventors for a limited period of time was a reasonable character of reward. They knew that there had been in this country, and doubtless in others, some subjects for which the State had offered rewards, such, for instance, as the important discovery of the longitude at sea, for which a State grant was made to Harrison. Then again, there was the north-west passage, which the State thought of so much importance that its discoverer would be deserving of a large national reward, and although the State by these acts had recognised the right of reward for great services, it was obvious that with regard to the greater number of inventions such a mode of reward was utterly inapplicable. It had been said by some gentlemen who did not deny the right to a reward, that it would be better to give that reward out of some public fund. He thought, however, that the greater part of the meeting would adopt the views ennnciated by Captain Selwyn, that, however desirable a public board might be to decide as to the novelty of any particular invention, the public were after all the best judges. No public department could successfully accomplish the desired object, so that they were brought back to the system already adopted in this and other countries. It seemed to be considered that whether in connection with literature, science, art, or invention, protection of the inventor was the most convenient, the justest, and the best reward which could be bestowed upon him. All that was done was that, for a limited time, he was allowed the use of his invention before the general public could have the benefit of it. He could not himself see what injustice there was to the public in that. He would refer them to statute of James I., and ask them if the words of the statute could be improved; and when it was said that this law was a relic of the olden time, it must not be forgotten that America adopted the principle of it in 1790; and that in 1791, at a time when privileges were not very much upheld in France, it was also adopted by that country, and since that time the same principle had been introduced into other countries. The words of the statute, which was for awarding monopolies, were, that it should not extend to letters patent for the term of fourteen years for the sale, working, and making of new manufactures, which shall be "neither unjust, mischievous to the State, nor hurtful to trade, nor generally inconvenient. Could there be a better definition of what the public should reward than that? Something had been said about the patent law being injurious to free trade, but it seemed to be forgotten that all the greatest political economists of our country were in its favour, Adam Smith, Bentham, and John Stuart Mill; and, therefore, when gentlemen talked about its being in opposition to free trade, and looked upon those who supported it as being still in ignorance of sound economical principles, they might be fairly answered that opinions coming from such men as he had just mentioned were at least worth consideration. He would also ask those gentlemen to remember that all the existing laws of copyright had been passed in the present reign, and that only two years ago this very society, by its own laborious efforts, succeeded in getting an act passed for giving artists a copyright in their works, so that this species of protection was not such antiquated legislation as some people described it to be. Then it was said that the present system was unjust to inventors; but he would rather let the inventors determine that question for themselves, and they certainly seemed to be satisfied with the principle of the protection afforded to them, and to desire to preserve it. The gentleman who spoke last had complained that under the present system one was rewarded while another was not, but he was very much afraid that that would be found to be the case in all things in this life. Then the question remained whether it was an injustice to the public that an invention upon which a very large amount of time, and labour, and capital had been expended should be preserved to the use of the inventor for a certain time before the public had the benefit of it. It certainly seemed to him that to defer for a time the enjoyment by the public of the fruits of intellectual labour, employed in important experiments, producing discoveries of much value, was not unjust to the public, and did not obstruct economical progress, and this plan possessed the recommendation of graduating the reward by the extent to which the invention was usefully employed. He would only add that the wondrous extension of our manu-

factures and commerce during the last ten years would seem to show that, whatever other effects might have resulted from the law of patents, it had not hindered the growth of national wealth. He would now, in the name of the meeting, express to Mr. Webster their warmest thanks for the able paper which he had read, a paper which was exceedingly moderate in its tone, and which had therefore brought the subject before them in the best form for consideration.

Mr. Webster said he felt very thankful to the meeting for the way in which they had received the chairman's proposal of a vote of thanks to him, and he would take the opportunity which was now afforded him of making a few observations on some of the points which had been raised in the discussion. He would say at the outset that he really felt very great satisfaction in bringing this subject before the Society, and he believed that much good would result from the discussion which had just taken place. The discussion was certainly a very exhaustive one, and there was hardly a single point which had not been raised. There was no doubt at all that there were very great inconveniences in the present patent law system, and the cost of litigation itself in connection with it was a scandal to the country, though he admitted that this was a matter with which a strong hand could deal. He would not go into detail on legal matters, but there was one point to which he would just refer, and that was that it had been decided that the user of a machine under any circumstances might be liable. That decision, however, had been doubted by a very great authority, and he thought that it was a matter which ought to receive very serious consideration. There was also another question, as to how far a person who was merely the possessor of a patent ought to have the privileges of a patent law extended to him. They all knew how the matter had been dealt with by the present Lord Chancellor; but these were questions which deserved the greatest attention, and if the suggestions which had been made during the discussion were carried out, it would certainly be a step in the right direction. He could only repeat what he had said before, that he did not believe it was expedient to grant patent right as a matter of course. Lord Stanley, in a discussion which was held some years ago, stated that he conceived the only patent right was a right to bring an action, which right should not be granted as a matter of course; and if this were more borne in mind, much of the present opprobrium would be removed. With regard to the appointment of a tribunal for adjusting the rights of the public and of the inventor, there was no doubt that it was a matter of extreme difficulty, and he thought that Sir Edward Belcher and Captain Selwyn had really disposed of that question, and he himself believed that it was impossible for any board of experts to value an invention, which was a matter to be left to the public alone, and then, after the public had valued it, they would find men coming forward to purchase it at its value. He was very glad indeed to see their old friend Mr. Macfie, who had been for so many years a staunch opponent of the present system, though not of the rights of inventors, because he must do him the justice to say that, although he had spoken very strongly on the subject, he had yet always been the consistent advocate of licenses. With regard to what Mr. Winkworth had observed about what Mr. Brunel had said as to the soap trade, he only wished that Mr. Brunel were present, and then he would have asked him which he had found to be the greatest obstruction to the soap trade, the excise or the patent laws. There, in the excise, they had an instance of the most scandalous abuse in restricting invention. It was almost blotted from the statute book, and he hoped that it would soon be abolished altogether. Another topic of some importance had been referred to by some of the speakers, one of whom had asked whether, in order to prevent the taking out of a patent by some one else, he was to advertise his invention in the newspapers? No, certainly not; but he could do this: on the payment of a small fee (and he wished it were less) he could record his invention at the Patent Office in the shape of a provisional specification. That was one of the objects of the new patent law, to provide a means of recording inventions. It was no doubt a very great hardship for a man to make an invention, and after a time to abandon it, and then find afterwards that somebody else had taken out a patent for the same thing, and that he could not use his own invention without being put to a great deal of trouble and expense in litigation. It must be remembered, however, that the patent law did not so much reward the inventor because he was an inventor, but the man who gave the public the benefit of the invention; and this was recognised in the fact that patents were granted to the importers of inventions, the policy of which entirely rested upon this principle, that this was for the good of the public, and for that reason the man was rewarded, and not for being the successful inventor. If the matter was looked at in this view, it would be seen that it was out of regard to the public benefit that the reward was given. Professor Wanklyn seemed to conclude that, because science was not rewarded as it ought to be, therefore the practical arts, as developed in inventions, ought not to be rewarded, but that certainly was no valid argument against the system. He wished the meeting particularly to bear in mind the distinction which he had pointed out the other evening between an inventor and a discoverer, and he utterly denied that there was any analogy between the cases at all. With regard to preliminary examinations, there was a great difficulty in knowing what one single step might lead to, as an inventor was very often before his age. He had referred, in his paper, to the fallacies into which some persons fell in connection with this subject, and he thought that Mr. Hastings had fallen into an entire fallacy in what he had said about territorial grants, because the fact was that it was altogether a false analogy. In the matter of discovering a new country it was entirely a question of first occupancy, which was the basis of all holding of property; that was merely discovering what was in existence before; but in a patent a thing was created which did not before exist, and for that a reward was given. An allusion had been made to Dobbs's case, and he was glad to have an opportunity of mentioning it, because he thought it was an illustration of the advantage that would have resulted from a preliminary inquiry, inasmuch as if such an inquiry had taken place all the litigation would have been avoided. If a preliminary inquiry were held at an early stage, the inventor would not have to go on blindfolded as he did now; but if he went on after he knew the real state of the case it would be on his own responsibility. With regard to the annual payments, there might be difficulties in the way, but the periodical payments had been very serviceable, and he had no doubt that yearly payments would be found to be the same. He had only one other thing to mention, and that was with respect to the screw-propeller, which, but for the patent laws, never would have been started. The Archimedean Company established it under the operation of the patent laws, and hence its success. With these observations, he would again thank the meeting for the manner in which they had entered into the subject, and he hoped that much good would result from the discussion.

(To be continued.)

THE AMERICAN PATENT COMMISSIONER ON THE POLICY OF PATENTS.

[From the *Engineer*.]

The law requiring the Commissioner of Patents to communicate to Congress an annual report contemplates that, in addition to statistical statements and tables, he should present his reflections upon the working of the laws he is called upon to administer, and exhibit a view of the progress of the arts of the country, which it is his peculiar privilege to observe. The present Commissioner, in his last report, observes:—In discharging this duty I shall take the liberty of departing from the formality of a mere official communication, and address myself, through Congress, by whose munificence the reports of this office are so widely disseminated, to the public, for whose benefit they are mainly intended.

The subjects to which I shall call attention are—the policy of any system of protection by patents; the advantages of our own system as compared with those of other leading industrial nations, and particularly Great Britain; the state of the industrial arts in this country, as exhibited by the inventions examined in this office within the last one or two years; and the modifications of patent laws which, in my judgment, would give greater efficiency to our patent system.

I am aware that, to most inventors in this country, it would seem not less preposterous to question the right of property, or the fundamental laws of morality, than to inquire into the right and policy of granting patents for inventions; but we cannot shut our eyes to the fact that, within the last few years, the policy of patent laws has been the subject of grave discussion in Europe. No later than 1862 a distinguished member of the House of Commons, in England, gave notice of a motion to consider, not the working, but the policy of the patent law itself; and in a debate which arose in May, 1862, upon a motion of Sir Hugh Cairns for an address to the Crown, praying for the appointment of a commission to inquire into the working of the law relating to patents for inventions, members of Parliament stated that, year by year, the opinion had grown more general that, practically, patents did more harm than good to inventors. In 1852 a select committee of the House of Lords was appointed to consider a bill proposed to amend the then existing law of patents. The voluminous evidence taken before this committee has been published, and is full of instruction as to the working of the patent laws in Great Britain, and the questions which arose as to the policy of those laws. The character of the questions which were raised as to the policy of any patent system is exhibited by some of the interrogatories proposed by the committee:—

"Do you think that the fact of a patent being granted is a considerable obstruction to anybody else inventing in that line?"

"You think that in no case where a useful improvement in the course of a manufacture suggests itself to the mind of a man, he would be deterred from making that improvement for fear of being dragged into litigation by reason of his infringing some other patent?"

"Do you not think that the stimulus which a patent gives to a man withdraws a great many ingenious artizans from their usual and more useful work in order to invent things which, when invented, are of no use whatever?"

A question put to Mr. Brunel, an engineer of acknowledged eminence, is, "The result of your evidence is, that you are very decidedly of opinion that the whole patent system should be abolished?"

His answer is: "Yes; I think it would be an immense benefit to that unfortunate class of men whom we call inventors, who are at present ruined and their families ruined, and who I believe are a great injury to society."

"And you think that those consequences, such as ruin to inventors and evils of that description, would subsist equally, though the patent laws were made simple and effective?"

"Yes, I think they would be very much increased; and if patents are continued, I hope the principle will be carried out thoroughly, and then it will not stand for two years."

"I can see every day that the poorer class of inventors ruin themselves by the attempt to work out some idea for the sake of getting a patent, while in all probability, if the man had gone to his master and said, 'Well, it strikes me that by such a means we should be able to get through more work and do something better; what do you think about it?' the chances are that most masters would, if they saw it was a good idea, give the man £1 or a £5 note; and the man the next day would be at work at something else, and you would have out of that man's brains an immensely greater portion of invention, and I believe he would get much better paid for it. I believe he would really make money; whereas now, everybody acquainted with these men knows that they lose money by it, and that an inventor, a schemer, is a poor man, who is more likely to go to the workhouse than anything else."

Mr. J. L. Ricardo, a member of the House of Commons, in his answer to the questions of the committee, forced the free-trade doctrines of his eminent namesake to the utmost verge.

He says: "The result of my experience and observation has been a conviction that the whole system of granting patents at all is very injurious to the community generally, and certainly not of any advantage whatever to the inventor. I consider that it is in a great measure a delusion upon the inventor to suppose that the patent privileges which are granted to him render his invention more valuable than it would be supposing there did not exist any monopoly with regard to it." He regards a monopoly with respect to a particular trade as being in exactly the same situation as a monopoly respecting any particular invention. "The object of a patent is to monopolise a particular trade." He quotes Mr. Say, who considers a patent as a recompense which the Government grants to the inventor at the expense of the consumer. He quotes the opinion of Lord Kenyon, in the case of Hornblower against Bolton, in which he says: "I confess I am not one of those who greatly favour patents; for although in many instances, and particularly in this, the public are greatly favoured by them, yet, on striking the balance on the subject, I think that great oppression is practised on inferior mechanics by those who are more opulent." He does not refer to the views of Lord Mansfield, the great founder of commercial law, who held that "in all work of the mind and of genius the common law of England ought to be held as giving an absolute property." He refers to Lord Bacon, who, in his advice to Sir George Villiers, says: "Especial care must be taken that monopolies, which are the canker of all trading, be not admitted under the specious pretext of public good." But he makes no mention of the tribute to inventive genius which Lord Bacon proposes in his "Atlantis," where he says: "Upon every invention of value we erect a statue to the inventor, and give him a liberal and honourable reward."

The objectors to the policy of a system of protection by patents, as appears by the questions propounded by the committee of the House of Lords, and the answers above quoted, may be resolved into three classes:—

1. Those who honestly doubt whether the system of patents affects the assumed development of the industrial resources of the nation; 2. Those who believe that the progress of a nation is to be secured only through the encouragement and instrumentality of the favoured classes; and 3. Those who, carrying the abstract principles of free-trade to too great a generalisation, deny the policy of any law which savours of a monopoly, or effects even a temporary protection of industry or genius. The objections of the first class I will hereafter attempt to answer in detail. Those of the second class, not openly favoured under the present political condition of affairs in this country, have found sympathy with a class now—happily, perhaps—removed from us, who always regarded with contempt the poor inventors of the North. It is this spirit which breathes in the language of the eminent engineer, who conceives that the poor inventor would be sufficiently rewarded by receiving a £1 or a £5 note from his master. It is unnecessary to reply seriously to this class of objectors. They can be found only in a country where the avowed objects of the laws which regulate the descent of property are the concentration of wealth in the hands of the few, and the support of hereditary aristocracy; where the husbandmen on small properties have been driven from the land, in order that 2,000 proprietors may possess among them one-third of the land, and the total revenue of the three kingdoms; where the doctrines of political economy prevail that large farms, large machine shops, large cotton mills, and large ironworks can produce cheaper than small ones, and therefore very properly supersede and obliterate them; and where a theologian no less respected than Dr. Chalmers can be found to affirm the blessings of a splendid aristocracy, "that from this higher galaxy of rank and fortune there are droppings, as it were, of a bland and benign influence on the general platform of humanity."

There is, unfortunately, in this country, more sympathy with the last class of objectors, who regard, with Mr. Ricardo, a patent obnoxious, as a remnant of the old abuse of monopolies, by which an individual obtained from the Crown the exclusive right to exercise some particular trade, and who consider the patent laws as a product of the semi-barbarous age of Queen Elizabeth. During her reign the sole right to buy and provide steel within her realm was granted to a single nobleman. The sale of salt, starch, leather, paper, &c., was restricted to favoured persons, who, in some cases, raised the prices to 1,000 per cent. and upwards. It was this class of monopolies against which Lord Bacon inveighed. The evils of this policy increased to such an extent, that it was considered by the Parliament of James I. altogether incompatible with the prosperity of the country. This feeling produced, in the 21st of James I., the famous "statute of monopolies"—famous not only for the abolition of the former unjust monopolies of trade, but for establishing the rights of inventors, which date, according to Blackstone and other English jurists, from that law. The statute suppresses monopolies by making void the future grants of all such as do not come under the following proviso:—"Provided also, and be it enacted, that any declaration before mentioned shall not extend to any letters patent and grants of privileges for the term of fourteen years or under, hereafter to be made, of the sole working or making of any manner of new manufacture within the realm, to the true and first inventor or inventors of such manufacture, which others at the time of making such letters patent shall not use, so as also they be not contrary to law, nor mischievous to the state, by raising the prices of commodities at home, or hurtful of trade, or generally inconvenient." Certain patents, more of the character of the old monopolies of trading, which paid a yearly rent to the exchequer, were exempted from the operation of the statute. The date of the act was 1624. In 1639, great discontent having arisen in the public mind with respect to the monopolies and privileges which remained, there was issued a proclamation abolishing a great many of the privileges which still existed, and, among others, "all patents for new inventions not put in practice from the date of their respective grants." There was thus in the general statute abolishing monopolies, and the subsequent proclamation clearing away such as subsisted, a distinct recognition of the claims of useful inventions to exemption.

It is a curious fact in the general history of the origin of the patent policy, that the original object in granting patent privileges in France, as stated by M. Wolowski, professor of commercial legislation, in the evidence before the committee of the House of Lords, was to break up the monopoly of the guilds of trade, which formerly existed in France, as well as in almost every city in Europe. All the persons practising any one art or trade in a particular city, such as the tailors, the brewers, the tanners, the goldsmiths, &c., were united into a company, which received from the government the exclusive right to practise their vocation. The competition of the art or trade was thus restricted to those who had been made free of the company; and no person could be made free until he had complied with regulations, often intentionally made numerous and vexatious, in order to prevent too many persons entering the business. No member of the guild could work, except in conformity with its rules. An inventor of any improvement in the trades practised by the guild, not a member thereof, could not employ his own invention; a patent gave the inventor the right of working individually, in derogation of the chartered monopoly of the guild. According to M. Wolowski, patents are now granted in Austria for the same object. Thus, the dawn of the rights of inventors has been actually coeval with the destruction of monopolies, odious to the common justice of men. And the common sense of mankind has marked a distinction between such monopolies and the exclusive rights conceded to inventors. Their rights under patents are called monopolies only from the poverty of language, which has failed to express in words a distinction which no less clearly exists. The odious monopolies, or those properly so-called, such as were given in the time of Elizabeth, for the sale of salt, starch, paper, steel, &c., were grants simply to aid individuals in amassing wealth, and favoured the aggregation of property in a few hands without opening new sources of national wealth, and were thus in derogation of the rights of others without compensatory public benefit, and were, therefore, positively injurious. Prof. Bowen has shown, in opposition to the dogmas of Adam Smith, that individual and national wealth are not identical; that individuals grow rich by the acquisition of wealth previously existing; nations, by the creation of wealth that did not previously exist. "Invention," says Mr. Ray, according to Prof. Bowen, "is the only power on earth that can be said to create. It enters as an essential element into the process of the increase of national wealth, because that process is a creation, and not an acquisition. It does not necessarily enter into the process of the increase of individual wealth, because that may be simply an acquisition, not a creation." "Hence," continues Mr. Bowen, "the most frequent cause of the increase of national wealth is the increase of the skill, dexterity, and judgment, and of the mechanical contrivances, with which national labour is applied." In this view, how can a monopoly of a trade be compared with the exclusive right in an invention? How can the exclusive privilege to sell salt in Elizabeth's time, which added not one bushel to the production, but which enriched the monopolist and robbed the community, as was the fact, by raising the price from sixteen pence a bushel to fifteen shillings, and the exclusive right of Whitney to his invention of the cotton gin, which has added hundreds of millions to the products and exports of the country, be both branded, with equal justice, with the odious name of monopoly?

The argument of the distinguished member of Parliament, Mr. Ricardo, against patents, on the ground of their being monopolies, may have less weight when the immediate practical grounds of his objections are considered. It appears from his evidence before the committee that he was chairman of the Electric Telegraph Company—the great company which, under Messrs. Cooke & Wheatstone's patents, and a charter from Parliament, exclusively controlled the system of telegraphic communication in England.

It appears that the company paid for the patent rights under Messrs. Cooke & Wheatstone, the sum of £140,000, and that the company had paid

nearly £200,000 in buying patents, and litigating them; that the company had bought up a very large number of patents which interfered with their exclusive rights, because they had made it a rule, if a man offered reasonable terms, to buy an invention, however bad it might be, sooner than litigate it; and that they paid for one patent—that of Mr. Bains—£8,000 or £9,000, which, although it did not quite come up to the expectation of the company, they found useful in combination with other patents. The obvious question occurs how, but for the existence of the patent laws which recognised the rights of the company to the exclusive use of Messrs. Cooke & Wheatstone's and Mr. Bains' patent, for which they had paid the inventor a full equivalent, could they have had the means of reimbursing themselves for the vast expenditure for the original and competing patents? What more instructive illustration could be found, except the whole free-trade policy of Great Britain, of the fallacy of political economy founded simply upon the individual interests of men and nations?

It is gratifying to observe that Mr. J. S. Mill, admitted to be the ablest living writer upon political economy, and a strong advocate of free trade, thus frankly admits the reasonableness of granting patent rights:—"The condemnation of monopolies," he says, "ought not to extend to patents, by which the originator of a new process is permitted to enjoy, for a limited period, the exclusive privilege of using his own improvement. This is not making the commodity dearer for his benefit, but merely postponing a part of the increased cheapness which the public owe to the inventor, in order to compensate and reward him for the service. That he ought to be both compensated and rewarded for it, will not be denied; and also, that if all were at once allowed to avail themselves of his ingenuity, without having shared the labours or the expenses which he had to incur in bringing his idea into a practical shape, either such expenses and labours would be undergone by nobody, except by very opulent and very public-spirited persons, or the State must put a value on the service rendered by the inventor, and make him a public grant. This has been done in some instances (as when Parliament offered a reward of £20,000 for a method of finding a ship's longitude at sea), and may be done without inconvenience, in cases of very conspicuous public benefit; but, in general, an exclusive privilege of temporary duration is preferable, because it leaves nothing to any one's discretion; because the reward conferred by it depends upon the inventions being found useful, and the greater the usefulness the greater the reward; and because it is paid by the very persons to whom the service is rendered, the consumers of the commodity."—*Political Economy*, vol. ii., p. 497.

CORRESPONDENCE.

TELEGRAPH COMMUNICATION ON RAILWAYS.

To the Editor of the Telegraphic Journal.

Sir,—Will you kindly give publicity to the following. It will, I have no doubt, lead to a little reformation. On Tuesday last I was a passenger by the 10.44 up train from Putney in the evening; there were a great many passengers who had been waiting about three-quarters of an hour for two trains that were then overdue. Owing to some derangement, the 10.44 train did not arrive until 11.25, making three trains overdue. The station-master could give no reason for the delay, nor could he say when a train would arrive. In answer to my inquiry as to whether there was telegraph communication, he informed me there was, but that it was a distinct company altogether from the railway; the telegraph company's clerk had long since left, and there was no one else that understood the working of it.

How far this system may be carried out on other railways, I cannot say, but it is evident that such bad arrangement must cause great inconvenience to the public, and diminish to a certain extent the safe working of the line. If any accident or cause of delay arises, the station-master has no means, after the telegraph company's clerk has left, of being informed unless by special train. I think it but right that, as long as a railway station remains open for traffic, there should be some one upon the premises capable of working the telegraph. The station-master informed me that it was not required of him as a qualification, and he knew nothing about it. The London and South-Western Railway is, I believe, as a rule, a very well-managed line, and the company will, I have no doubt, see the necessity of remedying a defect that may be done at, comparatively speaking, so little cost, and will enhance the security and convenience of its passengers to a very great extent.—I am, sir, yours, &c.,

A Railway Passenger.

Patents.—A Berlin paper has the subjoined:—"The Minister of Commerce last year instituted an enquiry to ascertain whether the issue of patents for inventions had not become useless, owing to the progress of industry, and requested the forty-seven Chambers of Commerce, in Prussia, to give an opinion on the subject. Thirty-one of them have now replied that the abolition of patents would be advantageous in an industrial point of view, while the other sixteen express the opposite opinion. When the same question was submitted to the Chamber of Commerce, in 1853, only six were for suppressing patents."

PARLIAMENTARY NEWS.

THE RUSSO-AMERICAN TELEGRAPH.

Mr. Watkin asked the Secretary of State for the Colonies if any application had been made to her Majesty's Government, or to the local authorities, by or on behalf of Mr. Collins, the concessionnaire of the Russo-American line of telegraph, intended to pass viâ Behring's Straits, for permission to carry a portion of such line through British Columbia; and if so, whether such permission had been or was proposed to be given.

Mr. Cardwell said that such an application had been made to the Colonial-office, but it was not only an application to pass through British Columbia, but it was an application for an exclusive privilege. The answer returned granted the right of passage, but disapproving of that part of the application relating to exclusive privileges.

TELEGRAPHIC COMMUNICATION WITH THE PACIFIC, AND GOVERNMENT CONTROL OVER THE HUDSON'S BAY TERRITORY.

Mr. Crawford asked the Secretary of State for the Colonies whether any progress had been made in the negotiations between her Majesty's Government and the Hudson's Bay Company relative to the establishment of telegraphic communication with the Pacific through British North America, and whether arrangements for the future management of the territory of the Hudson's Bay Company were still the subject of negotiation.

Mr. A. Mills asked the Secretary of State for the Colonies whether her Majesty's Government exercised at the present moment any control over the territory claimed by the Hudson's Bay Company, and stated in their prospectus, issued in July last, to comprise 1,400,000 square miles; and whether it was in contemplation to establish a Crown colony in any portion of this territory.

Mr. Cardwell said no authority was exercised over the territory in question, except by the Hudson's Bay Company. Negotiations had been for some time in progress between her Majesty's Government and the Hudson's Bay Company, having for their object the transfer of a large portion of that territory to the Government of the Crown, in order to found a colony in Rupert's Land, and to establish telegraphic communication with the Pacific. These negotiations had been going on since last session, but as yet no answer had been received.

LAW INTELLIGENCE.

Newall *v.* Elliot and others.—This was an action for the infringement of a patent for laying down submarine electric telegraph cables. The trial, which took place before the Lord Chief Baron at the sittings in Middlesex after last Hilary Term, occupied five days, and resulted in a verdict for the plaintiff on all the issues, with 40s. damages. The alleged infringement was in the laying down of the cable from Rangoon to Singapore in November, 1860. The case now came before the Court of Exchequer upon a rule to enter the verdict for the defendant, or for a new trial.—Mr. Grove, Q.C., the Hon. George Denman, Q.C., Mr. Serjeant Ballantine, Mr. Quain, and Mr. Markby were counsel for the plaintiff; and Mr. M. Chambers, Q.C., Mr. Cleasby, Q.C., and Mr. Bidder for the defendants.—The arguments of counsel have occupied the greater part of four days.—The Lord Chief Baron said that the object of the rule was, first, to enter a verdict for the defendants upon the question of the infringement of the patent; and next, for a new trial on the ground that the verdict of the jury was, if not altogether unsupported by the evidence, undoubtedly contrary to the weight of evidence; and thirdly, a question was raised with respect to the validity of the patent itself. With regard to the first point they were all of opinion—his brother Martin entertained some doubt upon the question, but not sufficient to differ from the rest of the court—that the verdict ought to be entered for the defendants on the infringement. They considered there was no evidence to go to the jury of any infringement, in point of fact, either in this country or elsewhere. With respect to the second point, the court had nothing but a choice of difficulties—viz., to give the defendants the benefit of a new trial on the ground of the verdict being against the weight of evidence, or to deprive him of that, and allow the Court of Error to say whether there was any evidence at all, and if there was, the verdict for the plaintiff would remain. As the counsel for the plaintiff had refused to consent to any arrangement, which would have prevented that, he did not see how the court could do justice between the parties without following the precedent originally adopted by this court, and followed by the Courts of Queen's Bench and Common Pleas, and suspending the question of a new trial until the judgment of the Exchequer Chamber, or perhaps, the House of Lords, on the point of law, had been obtained. The result of the judgment of the court would be, that the rule should be made absolute to enter the verdict for the defendants on the point of infringement, that the question of a new trial should be reserved, and that the rule should be discharged with respect to all the other matters.—Mr. Baron Martin said that while concurring in the judgment of the rest of the court, if the decision of the case had

depended entirely on his opinion he would have made the rule absolute for a new trial, although he personally did not entertain much doubt that there was no evidence of an infringement to go to the jury.—Mr. Baron Bramwell was of opinion that the verdict should be entered for the defendants on the issue of not guilty, there being no evidence of any infringement of the patent.—Mr. Baron Channell expressed the same opinion.—Rule absolute accordingly to enter a verdict for the defendants on the plea of not guilty.

TELEGRAPHIC NEWS.

BRISBANE, QUEENSLAND.—The northern telegraph extension in this colony is being rapidly proceeded with.

THE MAGNETIC TELEGRAPH COMPANY.—The wires of the above Company on the Dublin and Wexford Railway have been completed as far as the new bridge at Avoca.

THE BONELLI TELEGRAPH COMPANY.—The allotment of shares in the above company took place on the 30th ult. We understand that the company intend to proceed at once to construct their lines between London, Liverpool, Glasgow, Manchester, &c., and ultimately to Ireland.

INSTITUTION OF CIVIL ENGINEERS.—At the President's meeting on the evening of the 30th ult. various telegraphic instruments were exhibited, including those of Messrs. Siemens, Halske, & Co., the Bonelli Telegraph Company, W. T. Henley, Reid Brothers, Silver's India-rubber Works and Telegraph Cable Company.

QUEENSLAND.—The commercial relations of this colony with other countries is unmistakeably evidenced by the large amount annually derived from its various means of communication. From the census recently published, we find that the receipts of the post office last year were £11,481, while the income of the electric telegraph department amounted to £4,120.

NEW SOUTH WALES.—The railway traffic and telegraph business of our colonial possessions are rapidly increasing, and steps are being taken to further develop these two important systems in every direction. In New South Wales the increase in the receipts of the year 1863 over 1862, were, on railways, £33,747 18s., on telegraph messages, £8,464 7s.

ALARMING ACCIDENT IN THE VICINITY OF A TELEGRAPH STATION.—The following telegram was received by Messrs. Glass, Elliot, & Co., viâ Malta and Alexandria telegraph, from their superintendent at Malta, dated May 30th, 4.35 P.M.:—"Powder magazine exploded near Tripoli station. Forty men killed. Telegraph station much damaged. Clerks safe. Line joined through to Benghasi. Traffic with Alexandria not interfered with."

ANOTHER ATLANTIC TELEGRAPH COMPANY.—By a bill which has just passed the Corps Legislatif in France, the convention entered into between the French Government and Messrs. Bowett, Simon, and Trotter for the establishment of a submarine line of telegraph between France and the United States, either direct or viâ the island of St. Pierre and Mequdon (Newfoundland) or the Azores, has been ratified.

ORAN AND CARTHAGENA CABLE.—We had, a few weeks ago, to announce to our readers a mishap in the effort to submerge the above cable. A sufficient length has now been manufactured at the works of the Telegraph Construction and Maintenance Company, Wharf-road, City-road, and East Greenwich, to replace the portion which was lost in the first attempt to submerge it. The depth of water between Oran and Carthagena is, on an average, 2,400 fathoms.

THE ELECTRIC AND INTERNATIONAL DRAMATIC CLUB.—The members of the above popular club gave their fifth entertainment at the Cabinet Theatre, Liverpool-street, King's Cross, on the 26th ult. The theatre was exceedingly well filled by the friends of the society. The following proved a very effective caste for the Messrs. Morton's comic drama, "All that glitters is not Gold":—Sir Arthur Lassell (Mr. Gerrard); Jasper Plum (Mr. Perry); Stephen Plum (Mr. James Cook); Frederick Plum (Mr. Tripe); Toby Twinkle (Mr. Coleman); Harris (Mr. Simmons); Lady Leatherbridge (Mrs. Malcolm); Lady Valeria Westendleigh (Miss Helen Gower); Martha Gibbs (Miss Agnes Burdett). The company fully appreciated the excellence of the performance, if we may judge from the hearty applause which it evoked. We were, like every one else present, much delighted with the acting of Mrs. Malcolm, the Misses Helen Gower, and Agnes Burdett, and with that of the "*Plums*," who certainly "*were not*," as insinuated, "*blighted*." Mr. Coleman, the "Galvanic Battery" of the evening, maintained a steady *current* of hilarity, and certainly kept the audience from re-Morse. In the intervals of the performance Mr. W. Eaton executed several fantasias on the pianoforte in a very creditable manner, and was deservingly applauded. The proceedings of the evening were brought to a conclusion by a representation of Mr. Fitsball's domestic drama, "The Momentous Question," in which the following amateurs took part:—Robert Shelly (Mr. Perry); James Greenfield (Mr. Garrard); Union Jack (Mr. Coleman); Chalk (Mr. Simmons); Moletrap (Mr. Hodges); Bachel Ryland (Miss Helen Gower); Fanny Dossett (Mrs. Malcolm). During the performance of this piece we were provoked to remonstrate with a few persons in the reserved seats for their persistent rude behaviour. If they are in any way connected with telegraph companies, this may come under their notice, and it is to be hoped that on a future occasion we shall be spared the painful duty of referring to their misconduct with greater severity.

THE PROGRESS OF TELEGRAPHY.—We are very anxious to be in possession of every information respecting the extension of telegraph lines both for public and private purposes. To our numerous subscribers abroad the information cannot but be interesting, as the progress of the science in distant lands is interesting to ourselves. To our foreign correspondents for the valuable information contributed from time to time to our columns, we return our most sincere thanks, and trust that we shall be honoured by the continuance of such favours. The progress of private telegraphy within the last few months at home has been most satisfactory. Private firms at Coventry and Derby have availed themselves of the great advantages which a ready, simple, and instantaneous means of communication afford them between their distant establishments. These works were executed, as we are informed, by Messrs. Reid Brothers, of the Wharf-road, City-road, London. The same firm has also just completed a line of telegraphy on the Portland and Weymouth Railway, and another between the city offices of Messrs. Corrie & Co. and their coal wharves at Purfleet, Essex.

FLOATING TELEGRAPH STATIONS.—Some years since Prince Albert, who was then an Elder Brother of the Trinity House, suggested that the light ships round our coasts should be connected with the shore by means of electric cables. The question was considered, but no means had then been considered by which a ship swinging at her moorings could be permanently connected with her cable, and the far-sighted proposal was not carried out. A company now forming proposes to do that which Prince Albert suggested should be done, their object being in the first place profit, but incidentally carrying out the Prince's philanthropic ideas. The first ships to which this novel extension of the present network of telegraphs will be applied are to be stationed off Scilly and Cape Race, and at both stations it is allowed that not only will a large telegraphic business be transacted, but that many salvage services will be performed beneficial to distressed ships' crews, and resulting in profit to the salvors for the services rendered.

THE PERSIAN GULF TELEGRAPH.—Advices just received through Bagdad and Beyrout describe the causes of delay in the transmission of intelligence through the telegraph to India, the submarine portion of which in the Persian Gulf was recently completed by Lieutenant-Colonel Stewart and Sir Charles Bright. It appears that 170 miles of the line from Bussorah to Bagdad are incomplete, and cannot be constructed on account of the disturbed state of the intervening country, the Arabs having revolted against their Turkish masters. The Porte undertook to construct this portion of the telegraph through the Pashalic of Bagdad; but in consequence of hostility from the Arabs, not a Turk, it is said, dare venture into the district unless protected by a military force. These Arabs, however, it is affirmed, would permit the English to carry on the work; yet so jealous are the Sultan's Government of our doing anything within his territory, that they would rather have this great undertaking indefinitely obstructed than permit us to act. The consequence is, that messages must be conveyed over the incomplete portion on horseback, which causes a delay of about six days. It appears also that this is not the only present cause of interruption, a break having occurred in the route from Bagdad to Constantinople, one stage from Bagdad, "where the line is so wretchedly looked after, and the Turks are so slow about repairs, that it is impossible to say when it will be again in working order." The details thus given furnish a literal confirmation to all that was predicted seven years ago when the English Government, after having encouraged the Euphrates Telegraph Company, which had been formed by Mr. Andrew, to incur a considerable outlay, suddenly abandoned the enterprise in order that the Turks themselves might carry it out, and that our own resources might be expended on the Red Sea line, where a million of British capital has been hopelessly sunk. [We shall refer to this important subject on a future occasion, especially with reference to the extraordinary claim urged on behalf of Mr. W. P. Andrew.—ED.]

MISCELLANEA.

PUCK AND THE ELECTRIC TELEGRAPH.—Writers on telegraphy have been in the habit of quoting the famous and prophetic words put in the mouth of Puck by our immortal bard, as to the ultimate triumph of the electric telegraph. In *Notes and Queries* of the 14th ult., a correspondent has contributed the following interesting information:—"In a collection of Fairy Stories and Folk Lore I made in India from verbal relation, there is mention of a fairy called Gŭrŭ Pŭck, said to have the head of a bird, with wings springing from his shoulders, indicative of his rapidity of movement. He is unquestionably the original of the Puck of Shakespeare, whose chief attribute, as manifested in the following lines, was celerity of locomotion:—

> "*Puck.* 'I'll put a girdle round about the earth
> In forty minutes.'

"Shakespeare's Puck, like the Indian fairy, sometimes wears the head of an animal:—

> "*Puck.* 'Sometimes a horse I'll be; sometimes a hound,
> A hog, a headless bear; sometimes a fire.'

Gŭrŭ Pŭck is the messenger of the higher powers; his eyes are lightning, and rays of fire issue from his body, in which respects Puck, the English fairy, also resembles him. H. C."

Novel Application of the Electric Light.—The *Echo* of Honfleur states that for some time past a person from Paris, with an official introduction, has been prosecuting a series of experiments with electric light in fishing. The fish attracted by this great light arrive in shoals at the surface of the water, and are easily taken with an ordinary net.

Waste Electricity to be used up.—At the last sitting of the Paris Academy of Sciences, a paper by M. Loir was sent by the Minister of the Interior, in which the author endeavoured to show that a quantity of electricity was produced in large factories, and might be turned to profitable account by means of the straps which generated it by their friction in communicating motion to the machinery.

Vested Interests v. The Public Weal.—The Pneumatic Despatch Company proposed to carry their tunnel through Holborn and Skinner-street to the General Post Office from Euston-square, and with that view they asked permission of the authorities of Christ's Hospital to carry it below the precincts of the hospital to avoid the great public inconvenience which would be caused by excavating through Newgate-street. The result has been that the governors of the hospital have entirely refused to allow any such work to be undertaken within their property. The Pneumatic Despatch Company have a Bill now passing through Parliament, by which they proposed to obtain compulsory power to effect their object of passing through the hospital, but they have met with such strong and decided opposition from the governors that they have withdrawn from the Bill the clauses which were meant to confer such compulsory powers.

Mr. Varley on the Atlantic Telegraph, at the Inauguration Banquet given by Mr. C. W. Field.—It is my opinion that you should get rid of the Government guarantee, which is of no benefit if the cable works, and none whatever should it unfortunately fail. It, however, fixes the maximum charge that can be made to the public, beyond which you cannot go, and this amount is, in my opinion, far too low, when it is considered that your cable will have to connect the whole of the vast telegraphic system in the United States, in Canada, in Nova Scotia, with the innumerable telegraphic ramifications of Great Britain, the continents of Europe, Africa, and Asia. At present there are between thirty and forty wires connecting England with Europe, and these are for the most part full of traffic. If, then, so many wires be required for the business between England and the rest of Europe, how many will be required to connect the one half of the world to the other—certainly more than one cable. If, then, your rates be so low that you have more work than your wire will transmit, great delay will be the consequence, and I am perfectly certain that, unless you charge very much more than the maximum fixed by the Government, your cable will be so deluged with work, that your telegraph will be slower than the mail packet. The only remedy for this is to charge so much money that the number of messages received within the twenty-four hours shall be sufficiently limited to be transmitted within that time, otherwise you would get more and more behind every day. A telegraph is of no use unless it does its work with certainty and despatch. If you take the steps I recommend, the commercial success of the undertaking is guaranteed. Your earnings will be vastly greater than what you have hitherto calculated. Why, the telegraph from New York to California has paid cent. per cent. per annum. If one wire be barely sufficient to transact the business between California and the rest of the United States, how is it possible that one wire shall be sufficient between Europe and America? I feel great confidence that when once a cable is successfully laid across the Atlantic, the demands upon it will be so great, that you will have to lay one or two per annum for the next twenty years, or even more. With regard to the science of the question. I claim to be a practical, as well as a theoretical man, and in order to study the best means of utilising your cable when laid, it occurred to me that the best method of proceeding was to construct an artificial Atlantic cable, possessing the same electrical conditions, and consequent retardation as that which the cable about to be manufactured will have. This I have succeeded in doing, and I have already tried a number of experiments in it. There is no doubt that through an Atlantic cable 1,900 miles in length, and of the dimensions of that now about to be made, eight words per minute can be transmitted, and I have considerable hope that we shall be able to increase that number to twelve or thirteen. Judging from the rates charged, and willingly paid, for messages between California and New York, and also between Alexandria and London, I feel no doubt whatever that if you charge so much per message as shall only just keep your cable from being blocked up with work, it will pay 200 or 300 per cent.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1298. W. Passmore, making light machines or apparatus (such as sewing machines, rotary hair-brushing machines, model machinery, electrical apparatus, small lathe or other machinery or apparatus to which band, line, or cog is applicable) self acting.

1303. G. Schaub, an improved mode of transmitting currents of electricity for telegraphic purposes.

NOTICES TO PROCEED.

241. N. J. Holmes, improvements as applied to the regulation of machinery for covering telegraph cables, wires, and other similar articles.

241. G. Canouil, an improved alarum and signalling apparatus.

PATENTS SEALED.

3012. J. G. Redman and G. Martin, improvements in compounds or compositions for coating or covering iron or wooden ships and vessels, metallic sheathing, telegraphic cables, and other objects, to preserve them from decay, fouling, or other destructive action.

3031. J. Harper, improvements in apparatus for straining wire.

PATENTS WHICH HAVE BECOME VOID.

1166. J. R. Hunt, improvements in the manufacture of gutta-percha and compounds thereof with other matters and substances.

1246. F. N. Gisborne, improvements in the construction of electric targets for rifle and gun practice.

PATENTS ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1378. F. N. Gisborne, improvements in the means of and apparatus for indicating the course to be steered in ships at sea, and in galvanic batteries to be used in some cases therewith.—Dated 1st June, 1861.

1329. C. S. Duncan, improvements in the construction of electric telegraph cables or ropes.—Dated 27th May, 1864.

PATENTS ON WHICH THE STAMP DUTY OF ONE HUNDRED POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1665. A. V. Newton, an improvement in the manufacture of sulphuric acid.—A communication.—Dated 13th June, 1857.

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second „	1/7 to 1/8	„
third Negro-head	1/2 to 1/3	„
Java and Penang	1/4 to 1/5	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph	100	99 to 102	—
100	Submarine Telegraph, scrip.	all	48 to 53	—
all	Do. registered	all	⅜ to ⅝	—
5	United Kingdom Telegraph	3	1½ to ¾ dis.	—
10	Mediterranean Extension Tel.	all	3 to 4	—
5	London District Telegraph Co.	all	1 to 2	—

TO CORRESPONDENTS.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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THE PERSIAN GULF TELEGRAPH.

THE importance of the work in which Col. Stewart and Sir Charles Bright are now engaged increases daily, and their every movement is watched with the greatest interest at home and abroad. It is impossible to over-estimate the advantages which will result from the establishment of telegraphic communication with our Indian possessions, and we anticipate the success of this great undertaking as one calculated to inspire the friends of submarine telegraphy with greater confidence in other similar projects now in course of realization. In a previous number of this journal we laid before our readers a report, from the *Times of India*, of the progress made in the submersion of the Persian Gulf Telegraph cable, but as the account before-mentioned lacked many important details, we have endeavoured to procure accurate information, and have been favoured by Mr. Latimer Clark, the engineer of the Indian Government, with interesting particulars furnished by the correspondence of gentlemen engaged in the various operations in the Gulf. Mr. Latimer Clark writes :—

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—The following extracts from letters received from the gentlemen engaged in the Persian Gulf Telegraph expedition, may probably interest your readers.—I am, sir, your obedient servant,

June 8th, 1864. LATIMER CLARK.

April 26th. "We put four miles on board the Comet, and sent her round to Fao. The cable was used to get overland to the water's edge, but it was a long job carrying it in pieces, as you may imagine; about a mile was laid by boats, in a sort of canal running inland from the Shat-el-Arab side, but the rest had to be carried on men's backs. On the 4th, after the arrival of the Amberwitch (it blew too hard on the 3rd to do anything), we coiled five miles of cable into the Zenobia's two paddle-box boats, and the Coromandel's two barges, and at 10.30 A.M. on the 5th, started for shore, having buoyed the end of the cable a short distance from the Assaye. We went in as close as the Amberwitch's draught (12 feet) would allow, about four and a-half miles from the water's edge, and laid out the cable from her in the boats as far as we could. We stuck, however, about three-quarters of a mile from the water's edge, and as the tide was just on the turn (we had taken near high-water time for landing, and thus had about an hour of slack water to get in) we were soon high, but not dry, in the mud. How we got the cable from the boats to the end of the cable taken over the land, would make a good picture for *Punch*. The mud was so soft that it was impossible to walk, in fact we were up to our middles directly we got out of the boats, so we had to crawl through it on all fours like turtles, and you may imagine the figures we all presented, clothes, face, and hair, all over mud. However, we did the job, and got on board the Coromandel (which had gone round to the Shat-el-Arab, or Fao side, with Col. Stewart) for the night.

"The cable has behaved remarkably well throughout; we have had no sticking, not a single broken wire (against which the outer covering is a capital guard), and the testing has been wonderfully uniform throughout. The most perfect goodwill exists throughout the whole fleet, from the senior officer down to the cabin-boys, and likewise amongst our own staff, and it is quite a pleasure to work under such circumstances. I should tell you that the line works admirably, that the messages go through excellently, and the whole system between Kurrachee and Fao is in perfect order; the land line from Gwadur to Kurrachee also works capitally; but between Kurrachee and Bombay the working is infamous and most irregular. Sometimes when the latter is working well we get a message from Bombay in half-an-hour, sometimes they are stopped for a whole day, and once for two days; good working is quite the exception. The Persian line, I am glad to say, offers promise of being finished soon, and as the Russians have now got into communication with Persia, by a line now at work passing through Tabreez to Teheran, it is not unlikely that after all, that route (meeting the cable at Bushire) will be the first open. Captain Champain, and several other R.E. officers and men are hard at work in different sections of the Bagdad, Ispahan, Shiraz, and Bushire line, and it is thought they will finish in July. The difficulty between Bagdad and the cable end at Fao or Bushire is but temporary, and may perhaps be turned to account at Constantinople in getting further concessions as to having European clerks, &c.; for here is another great difficulty between this and Constantinople at present, *all messages are translated from English to Turkish here, and back again at Constantinople.* Fancy a commercial message written at Bombay and the result as presented to the wondering merchant in London! This is, however, to some extent provided for in a convention just arranged in Constantinople, in which it is provided that the officials appointed shall be acquainted with the English language.

May 9th. "The Amberwitch went on ahead, and took up positions arranged at the most critical points, burning blue lights at night, and having a blue ensign at mast-head (when in position) by day. All went very well until 7 P.M. on the 4th, when we were struck by a tremendous squall, with rain, lightning, and clouds of fine sand. The sand was so dense that we could see nothing of the lights of the Zenobia, although she was of course close to us, as she has us in tow. The wind was very strong, and, getting under the awnings before we could furl them, acted like a mizen, and made the ship broach to in spite of her helm being hard up and the fore topmast staysail set, the only head sail we dared set for fear of its carrying away. The awning blew up into an immense arch, and then went off like a gun, breaking the heavy iron stanchions like carrots, and carrying them into the air, and then dashing them down on the deck, burying the break and machinery in the wreck. Fortunately nobody was hurt, although we had just called the watch below to furl awnings, and the quarter-deck was crowded with men. We cleared the wreck away as fast as possible, and most fortunately nothing got into the wheels, although the ridge chain of the awning took up a position on the top of the break-drum, which was going at 45 revolutions per minute, or 8½ knots an hour, although the Zonobia's engines were stopped. I think you will allow that this rate says something for our paying-out arrangements. The dust or sand was wonderful. We were all like millers with grey beards and hair, and could hardly see out of our eyes. Fortunately the wind died away before we came to the end of the cable, which we did at about 11 P.M. We buoyed the cable all night with two buoys and a flag buoy, and then ran for Ormarra. We got in there on the 5th at daylight. The ship looked like an Arctic ship in the winter. She was white from truck to gunwale, and about an inch of sand all over her decks. I got the Amberwitch astern of us same day, and took out all odds and ends from Assaye, and pulled machinery to pieces.

6th. "Waiting for Cospatrick; made arrangements with naval men for further operations on the rest of section.

7th. "Cospatrick arrived, commenced getting stores, &c., over.

8th, Sunday. "Rested, as we had not had a Sunday for some time, and everybody was fagged.

9th. "Came out (by arrangement) to anchor near buoys and pick them up at daylight.

"The Cospatrick to come out to-morrow at daylight. Have found buoys, but buoy on end is gone, and flag buoy has drifted. Buoy on bight all right. Shows the prudence of two buoys.

April 29th. "I write to inform you that the whole of the cables laid in the Persian Gulf work and test satisfactorily, the resistances being as follows :—

"GWADUR—MUSSENDOM SECTION.

March 16th. "Resistance of gutta-percha, 358 mills. per knot.
" copper, 6·7 units "

"This cable landed at Mussendom February 13th, the resistances then being—

"Gutta-percha, 339 mills. per knot.
Copper, 6·72 units ,,

"Mussendom—Bushire Section.

"This cable landed at Bushire March 24th.
March 25th. "Resistance of gutta-percha, 361 mills. per knot.
,, copper, 6·4 units ,,

"Bushire and Fao Section.

"Assaye anchored off Fao March 27th.
March 27th. "Gutta-percha resistance, 630 mills. per knot.
Copper ,, 6·68 units ,,

"There are three reasons why this section should test better than the other two: first, the cable is composed of the coils bearing low numbers, and first supplied by the Gutta-Percha Company—the coils, if you remember, had a very much greater resistance when tested at the Gutta-Percha Works than those supplied at a later date; the second reason, the greater age of the manufactured material; thirdly, the lower temperature of the water the cable is submerged in, the temperature being at the depth of 29 fathoms in Malcolm's Inlet 22°, and only 17° in 24 fathoms about 70 miles from Fao. From soundings at different parts of the Gulf, I find the temperature decreases slightly between Mussendom and Bushire, and very quickly between Bushire and Fao. The day after we anchored at Fao we were suddenly surprised by a loss of continuity in that section, while the insulation remained perfect. The distance by test showed it to be 93·33 miles from end of cable at Fao. This distance was determined by charge and discharge test, with the use of the condenser. After repairing the cable, and reducing the distance to a mile mark, picked up in cutting out the fault, the distance of the fault was found to have been from end of cable on board Assaye at Fao 93·4 miles. The cable broke on Monday at noon. Cable to the amount of twenty miles was put on board the Amberwitch. Test made from the Bushire end of line. Cable repaired, and Amberwitch back again at Fao by daylight the following Sunday, so that the landing of the cable at Fao was not delayed by this our first mishap at all.

"We have fortunately had beautiful weather for laying these three sections, and therefore tests are all that can be wished for. If the ship is rolling it is impossible to test the copper resistance, owing to a magneto-electric current being generated in the cable by the earth's magnetism; coming down to Gwadur these currents have been sufficiently strong to deflect Thomson's mirror galvanometer 140 divisions on each side when the ship was rolling 10° on each side, the sensibility of the instrument being with one cell, through 10,000 units, 1·45 divisions."

M. HIPP'S ELECTRIC SAFETY DISTANCE SIGNAL FOR RAILWAYS.

M. Hipp is an electrician of Neufchâtel, and the signal is patented as a communication to Mr. John Imray, engineer, London. The idea involved in its construction is extremely ingenious, but it would be hopeless to attempt to explain the mechanism without engravings. Suffice it to say that the signal consists of a column surmounted by a disc, which is turned edgeways to the line for safety, or flatways for danger; and for night signals it is provided with a lantern, with alternate white and red lenses, as usual. The disc is turned by means of a clock-weight descending in the inside of the column, which has to be wound up at intervals of two or three days, according to the number of times the signal is used. The mechanism on which the weight acts is stopped by an electro-magnetic detent, which is connected by conducting wires, like those of the telegraph, to a small battery and manipulating instrument at the station. The manipulating instrument is contained in a small case or cabinet fixed against the wall of the station-master's office. It consists of a handle or lever moving over an arc, half white for safety, and half red for danger—an electric bell, and an indicator or model disc, which always shows the same phase as the main disc on the distance signal. At any moment the station-master, by simple inspection of the instrument, sees how the signal stands, whether at "danger" or at "safety;" if at "danger," the handle is on the red, and the indicator disc shows red; if at "safety," the handle is on the white, and the indicator disc in the office shows white. When he desires to change the signal he moves the handle from red to white, or from white to red, as the case may be, and immediately the bell begins to sound, and continues to sound until the distance signal has turned, and the indicator disc has undergone a corresponding change. In case of any accident happening to the distance signal, of its mechanism being run down, or of its becoming stiff by grit, or rust, or violence, so that the weight cannot turn it, the bell at the station continues to ring, and the station-master can take temporary measures for safety. In case of anything happening to the electrical portion of the apparatus—the battery being exhausted or the wires being broken—the indicator disc shows, like a galvanometer, the absence of electric power, and the bell does not sound on moving the handle. In such case also the station-master can take temporary measures for safety.

This invention was exhibited at the recent conversazione of the Institution of Civil Engineers, and attracted considerable attention.

THE INTERNATIONAL EXHIBITION, 1862.

(Continued from page 270.)

2. *Magneto-Electric Machines used in connection with the Electric Lamp.*

The magneto-electric lights exhibited in Class VIII. illustrate a very important practical application of electricity. The production of the electric light from magneto-electricity is novel since 1851, and this important invention is believed by the writer to be entirely due to Mr. Holmes.

F. H. Holmes, M. (United Kingdom, 2,914), exhibits an effective arrangement of the magneto-electric machine for producing light. The currents are induced by the rapid passage of coils of copper wire wound round soft-iron cores between the poles of powerful horseshoe magnets. The alternately inverted currents produced in this manner are transmitted, by means of a commutator, in one direction only, through the carbon electrodes of the lamp, which has been already described, along with similar instruments, under the head of philosophical apparatus.

The coils, wound on bobbins, eighty-eight in all, are fixed in the rim of a large wheel about five feet in diameter, with their axes parallel to the axis of the wheel. They are arranged in two parallel rings, each containing forty-four equally-spaced bobbins. The centre of each bobbin in one ring corresponds with the centre of the space between two bobbins in the other ring. This wheel is driven at about 110 revolutions per minute. The horseshoe magnets are fixed in a frame round the circumference of the wheel, in three planes or rings of twenty-two each. The two poles of each magnet are in one and the same plane or ring. The distance between their poles is equal to the distance between the bobbins or coils. The magnets in the two outside rings have similar poles opposite one another. The magnets of the inner ring are placed with opposite poles facing the two similar poles of the outer rings. The two outside rings have compound magnets of four plates; the magnets of the inner ring, between the two sets of bobbins, have six plates. The weight of each plate is six pounds. The distance between the successive magnets corresponds to the distance between the centres of the coils, so that each alternate coil has a core magnetized in the opposite direction, but the wires are so connected that the induced currents flow in the same direction. The length of the hollow iron core inside each bobbin is 3½ inches, its external diameter 1¼ inch, its internal diameter 1 inch; two copper wires, No. 9, B. W. G. (0·148 inch diameter), 45 feet long, are wound round each core, and connected in double arc. These wires are equivalent to one wire 0·2 inch diameter of the same length. The core and brass bobbin are split to prevent useless currents outside the coils.

As the wheel revolves each core continually changes its polarity as it passes between the alternating poles of successive pairs of magnets. This change of polarity occurs forty-four times for each coil of each ring; the change is simultaneous for all the coils in one ring, but the moment of maximum change of one ring corresponds to the moment of minimum change in the other. All the coils of each ring are connected in series, and it will be seen from the above description that each ring will induce forty-four distinct currents, each due to forty-four coils during each revolution of the wheel. The coils of both rings are connected with an ingenious commutator, by which they are so combined that the induced currents shall continually pass in the same direction through the carbon electrodes of

the lamp, although passing in four distinct successive combinations through the coils. As already stated, the maximum current from one ring corresponds with the minimum current from the other, and as each current lasts a very sensible time, during which it gradually rises and falls, their combination does not simply produce twice the number of sparks that would be obtained from one ring of coils, but a nearly constant and uniform current, in which the fall of the current from one series of coils is almost exactly compensated by the rise of the current from the other. This effect is said to be very apparent when the currents, first from a single ring, and then from the two combined, are made to record their passage on a moving slip of paper by Bain's electro-chemical process. As each revolution induces eighty-eight distinct currents the machine, when driven at the speed mentioned, sends 9,680 currents through the carbons every minute.

Great pains appear to have been taken to ascertain the best length and section of wire, the best dimensions for the bobbin and for the soft-iron core, together with the speed at which the coils should pass the magnets to produce a maximum effect. At a slow speed the currents will obviously be weak, but if the speed be increased beyond a certain point, the soft-iron cores have not time to acquire their maximum polarities in passing the magnets, and the induced currents consequently fall off in intensity. The bearings of the wheel are double cones, intended to prevent any lateral motion which might bring the ends of the coils in contact with the magnets.

The commutator consists of two massive brass wheels on the main shaft, and four brass rollers resting on the periphery of the brass wheels. The brass wheels are each divided into forty-four teeth. All the odd teeth are in connection with one another, and so are all the even teeth, but the odd teeth of each wheel are insulated from the even teeth. The teeth are separated at the periphery by a broad air space, but a projection of one so fits into a recess of its neighbour, that the rollers on the periphery at the very moment of leaving one tooth come into contact with the next one. One of the rollers is always on an odd, and the other on an even tooth of each wheel. The two ends of the wires of one ring of coils are connected respectively with the even and odd teeth of one wheel, the wires from the other ring are similarly connected with the other wheel. Two of the rollers (one on each wheel) are connected with the two electrodes of the lamp, and the two remaining rollers are directly connected together, and form the link which joins up the two rings of bobbins, first in one way and then in another. The change of rollers from odd to even teeth occurs on one wheel when the rollers of the other are on the middle of their teeth; this change corresponds for each wheel with the moment at which the cores of the corresponding coils are directly opposite the pole of a magnet. The result of this arrangement is to form four different combinations of the coils with the electrodes of the lamp, during all of which the current passes in one direction through the lamp, and continually circulates through the whole eighty-eight coils, all of which conspire to produce a current in the same direction. The large rollers have various adjustments and supports, and the dove-tailed recesses are ingeniously contrived, so that any sparks which occur at breaking contact shall not cause the surface to wear unequally. It is said that when the rollers are perfectly adjusted, and the coils and magnets perfectly spaced, no sparks are visible at the commutator, but sometimes sparks were to be observed on the machine exhibited, showing a certain loss of power.

The visible conversion of mechanical work into heat and light by the agency of electricity in this machine gives an interesting example of the transformation of energy. Mr. Holmes states that the excess of power required to drive the machine when the electric currents are closed is very sensible. One and a quarter horse-power are required to drive the machine when the light is in action.

The self-acting lamp regulator employed by Mr. Holmes does not differ in principle, although very different in detail, from those used in connection with batteries, and any one of the lamps already described might, with more or less success, be used with his machine; but probably none of them would, on the whole, give as good results as his own regulator, which has been already described, and which produced an admirably steady light.

Mr. Holmes' machine and lamp have been in successful operation at Dungeness lighthouse since last June, exclusively in the hands and under the care of the Trinity House. The secretary has kindly informed the writer that the Elder Brethren have not yet satisfied themselves whether the light is generally more brilliant than that at Grisnez, but that careful observations will be made during the winter months, which will enable them to arrive at a more satisfactory conclusion as to its merits.

A. Berlioz & Co., Paris, M. (France, 1,146), exhibit a machine for producing the magneto-electric light, which differs from that shown by Mr. Holmes, chiefly in the absence of the commutator. The coils are arranged in four parallel rings between five rings of horseshoe magnets. There are sixteen bobbins in each ring and eight magnets; the magnets are arranged as in Mr. Holmes' machine, but the bobbins are arranged four in a line, so that they all approach and recede from similar poles of the magnets at the same time. By this arrangement the currents from all the coils always agree in direction, and no commutator is required to prevent their neutralizing one another. The coils are all connected in series, and the two ends connected with the lamp. By this arrangement alternate currents in opposite directions are sent through the carbon points of the lamp, when the coils revolve past the magnets. This rapid alteration of currents passing from a maximum to a minimum, and again to a maximum, must partake somewhat of the nature of sparks, but no intermittence is perceived in the light produced.

Messrs. Berlioz use coils 3·9 inches long; the internal diameter of their hollow soft-iron cores is 1·4 inch, the external diameter 2 inches; round each core are wound eight wires, each one millimetre in diameter, and 16 metres long, joined in multiple arc; this is equivalent to one wire about 0·11 inch diameter, and 52½ feet long. The wire is insulated with cotton and asphalte varnish, and the coils are baked before being used. The magnets in the outside ring are made of three plates, weighing each about four kilogrammes, or 8·8 lbs.; the magnets of the inside rings have six plates. The diameter of the circle passing through the centre of the bobbins is one metre, or 3·28 feet. The machine makes 300 to 400 revolutions per minute; the speed of the coils is therefore nearly double that of the coils in Mr. Holmes' machine, but owing to the different arrangement of the coils, Messrs. Berlioz obtain only about 5,000 currents per minute.

This arrangement is extremely simple. No commutator is required, and no useless sparks can occur, for the circuit is never broken. The light is large and apparently steady, although accompanied by a certain crepitation with occasional flashes; it is to be regretted that the intensity of the light could not be measured, and that the machine could not be tried with Mr. Holmes' lamp. Messrs. Berlioz used Serrin's lamp, and the flashes sometimes seen were perhaps due to a peculiarity of this instrument. The light produced was apparently enveloped by a brownish cloud. It was not possible to determine what effect this cloud had in diminishing the intensity of the light. Messrs. Berlioz, or their assistant, M. Van Malderen, claim to have produced the first electro-magnetic light, in which the use of a commutator is dispensed with. The light was said to be equal to 125 "Becs Carcels," and the machine requires 1½ horse-power to drive it.

E. C. Shepard (United Kingdom, 1,985) exhibits in Class VIII. a magneto-electric machine originally intended for the production of illuminating gas by the decomposition of water. The arrangement of magnets and coils is very similar to that used by Mr. Holmes for his magneto-electric light machine; and it is said that Mr. Holmes' invention of the electric light was the result of an endeavour to discover a profitable use for Mr. Shepard's machine, when it was found that it could not be worked at a profit as a gas generator.

3. *Miscellaneous Practical Applications.*

T. Allan, M. (United Kingdom, 2,850), exhibits the only electro-magnetic engine that requires any special notice. In this arrangement the reciprocating motion of a piston-rod is imitated. This piston-rod has a series of collars, on which soft-iron discs rest loosely, and passes through the centre of a series of soft-iron cores enclosed in a set of electro-magnetic coils, which correspond in number and position to the soft-iron discs. When the piston is in its highest position, the upper disc is very near the pole of the upper electro-magnet, and each successive disc is further off from the pole of its electro-magnet. The current is first passed through the upper electro-magnet, which pulls down its disc and the rod; the current then goes through the next lower electro-magnet; the second disc is now so near its pole as to be strongly attracted, bringing the rod further down, and leaving the first disc behind; the third disc now takes up the work, and the second is left behind; this continues until the stroke is completed by the last and lowest disc. When the rod rises, its collars lift the several discs away

from the electro-magnets into their original position; four of these rods and sets of coils are combined with a four-throw crank, which receives a rotatory motion from them.

L. L. & H. P. Vulliamy, Clapham (United Kingdom, 2,982), exhibit a small model of an electro-magnetic engine, driven by the usual form of suction coil.

H. C. Hurry, Worcester (United Kingdom, 1,892); D. McCullum, Plymouth (United Kingdom, 1,916); and W. Steer, Nottingham (United Kingdom, 1,993), also exhibit electro-magnetic motive engines. These and all other similar machines are liable to the same objection—the enormous expense per foot-pound at which the work is produced.

F. N. Gisborne, M. (United Kingdom, 2,541), and Hemming & Co. [Chevalier M.] (United Kingdom, 2,547), each exhibit in Class XI. an electric target of essentially the same construction. The target is divided into any number of sections required, and behind each section a little ball or hammer is hung touching the plate, or a bolt rigidly connected with it; the plates forming each section are separately supported, so that when one is struck or shaken the others do not move. When any plate is struck its ball or hammer flies back under the influence of the vibration, and for a short time completes a circuit which includes a wire leading to the firing station, a battery, and an indicator, or receiving instrument of some kind. Each plate has a separate conducting wire and indicating needle in Mr. Hemming's target (Lang & Chevalier's patent), although reverse currents to give distinct signals might obviously be employed. Mr. Gisborne has proposed by the use of synchronous apparatus to use only one wire, but no such plan can be practically adopted at present. The conducting wires are generally small copper wires insulated with india-rubber or gutta-percha, and twisted into some form of cable. These targets have been practically tested, and found to answer. Electrically the problem presents no difficulty. Their advantages will, no doubt, be fully admitted in the report for Class XI.

M. Martin de Brettes was the first to propose the construction of an electric target showing *where* it was struck, but it is believed that his complicated arrangement was never carried out. The simple and effective form exhibited in this country is due to Messrs. Lang & Chevalier, and has been very slightly modified in the target exhibited by Mr. Gisborne. Professor Wheatstone used a target to show *when* it was struck in connection with his original chronoscope.

Single examples only are shown of the following miscellaneous applications of electricity:—

Siemens, Halske, & Co., M. (United Kingdom, 2,959), exhibit an *electric log*. Electricity is used to convey a signal to a step-by-step propelment or escapement inside the ship from an ordinary Massey's patent log at, say, every hundred turns of the vane, or at any other given fraction of a knot. An insulated wire is led from the ship to a train of wheelwork contained in an air-tight case, and driven by the vane of the log. This wheelwork makes the contact required at regular intervals, and these are marked by the index of the step-by-step instrument on board the ship. The log, therefore, need never be drawn in to be consulted, and the captain can at any time observe the speed of the ship. It is somewhat to be feared that the stuffing-box through which the connection of the wheelwork with the log is made will either offer so great a friction as to impede its free rotation, or will allow water to enter the case with the clockwork.

C. W. Harrison (United Kingdom, 1,615) exhibits in Class VII. an electro-magnetic hand-printing press. The voltaic current is here used to produce the required printing pressure by means of large electro-magnets with their armatures.

(To be continued.)

THE TELEGRAPH IN SPAIN.

We have from time to time endeavoured to keep our readers *au courant* with the foreign news concerning telegraphy. The difficulty we experience in obtaining information from the continent is increased by the restrictions imposed on the press, and by the inattention of local reporters to matters pertaining to the arts and sciences. War news is prolific, but notices of ministerial or other proceedings, having for their object the promotion and maintenance of peace, are hard to procure. We are indebted to a valued correspondent for the following documents respecting telegraphy, which have been published in Madrid. The measures lately submitted by the minister, Antonio Cánovas del Castillo, and sanctioned by the Queen, will place Spain in immediate telegraphic communication with all other continental nations, will effect a reduction in the tariff for messages, and tend materially to perpetuate the pacific relations of the several governments in Europe.

Ministry of State.

The proposed decree, which the Minister who subscribes submits to the approbation of your Majesty, has the double object of simplifying the service of telegraphs and to offer to the public new and greater facilities for utilizing this means of correspondence.

The receipts in cash from the number of telegraphic messages necessarily imposes upon the Administration certain obstacles, and in the end retards the communications, increasing and complicating the duties of the office. Of necessity the keeping of accounts requires a numerous staff, entirely separated from the proper duties of the department, and subject to all the inconveniences of direct payment from the hand of the sender of messages.

The result of this is that the Treasury is considerably burdened; that frequent disputes arise between the public and the officers of the stations; the necessity of certain requisites on the part of the senders, and the formalities in recovering the messages; the consequent loss of time; and, lastly, the management and detention of funds in departments entirely unconnected by their constitution with such kind of duties.

If the amount of telegraphic messages is not paid in cash, it will be much easier for that branch of the Administration to make the necessary preparations for the transmission of messages—a notorious advantage for the public—and even new channels for the conveyance of telegrams from localities where no stations are established; for the Treasury, an increase in its revenue by the increase of correspondence; for the service, a greater simplicity of proceedings, freed from all unnecessary responsibilities and, in a certain degree, exalted functions: objects which can be obtained by establishing the franking stamps for the telegraphic correspondence.

Such a convenient measure cannot be carried out, in the opinion of the Minister who subscribes, without suppressing certain advantages, more seeming than real, now granted to senders of messages, few of whom enjoy them—foreign to the nature of the telegraphic service, and which impede the rapidity of messages.

The present Administration of this branch, in order to inspire confidence in the senders of messages, does not limit itself to take the precautions required by the service, but lends itself to responsibilities and indemnifications useless to those that claim them, prejudicial to every one else, costly to the State, and never practised in any public department. Anxious, moreover, to obtain the patronage of the public, it goes the length of offering services unconnected with telegraphy to anticipate all kinds of necessities, and from this a multitude of complications and labours which it is necessary to suppress for the future.

If the liberty of correspondence be aspired to, it is necessary, while declaring free from certain obstacles to the public, that the Administration should also be free from an inconvenient tutelage interference, which thwarts its movements, but leave to private interest the care of its own guarantees, as with other services, and do not demand from the telegraph more than its own peculiar business, clear of officious additions, and irregular and unjust burdens, so prejudicial to its exclusive object.

The Minister who subscribes has borne in mind these considerations, when fixing the duties of the telegraphic offices, to deliver messages to the intended recipients within the radius of the town wherein they are established, adding only, when convenient, the forwarding per post, that public service being already established.

From the same grounds proceed the decisions that an acknowledgment of receipt is to be considered a new telegram. That each copy of a message in the same words to different persons in the same place is to be considered a distinct despatch, being so many different services performed for the sender, the perilous and always unsatisfactory personal identification of the recipients; the suppression for the future of a return of money for messages mis-sent or delayed, it being costly and difficult, never satisfactory to the sender, nor in the slightest degree augmenting the accuracy of the service; but, on the other hand, leading to tedious and numerous labours, which have to be paid for by the Treasury. In the introduction of insurance of telegraphs has been sought the only guarantee that can in particular cases be to the interest of the sender; and in regulating the rate of insurance to the trouble imposed, and the advantages to be enjoyed by those desirous

of that security, the character of an exceptional case has been given to it, without, however, conceding any advantages of priority to insured telegrams, inasmuch as exceptional benefits can only be given, so far as they do not interfere with public rights.

There still exists, moreover, a service not rigorously exacted by the public, but which may in exceptional cases be convenient, and which only imposes upon the stations a work of care and attention, that of replies paid for in anticipation. The modifications which, for the retention of this service, have been necessarily introduced in it arise from the indispensable condition of payment by stamps, to be cancelled at the time of presentation, and therefore not in any case returnable.

These alterations can, without difficulty, be applied to the inland telegraphy without any additional preparations but those purely material to its execution. It would only require to make the tariff between the Balearic Islands uniform with that of the Spanish stations in the Peninsula to avoid all unnecessary complication and motive for error; and this, which produces a reduction in the special tariff now existing for the correspondence of the islands, is already comprised in the project.

But if the payment by stamps did not become extensive simultaneous and equal to the international correspondence the object of this reform would be a failure, and would never be effective and beneficial; while amounts, no matter how small they might be, are to be paid in cash, and consequently causing the retention of pass-books and collections, and the officers of the accountant department. As all the difficulties and complications enumerated spring from the international telegraphic treaties, and have been admitted into the internal system solely to render correspondence uniform, the suppression of them in this enforces also their suppression in that sustained with other states. Spain would never be able to arrive at this result without annulling the agreements accepted by her, and without separating herself from other telegraphic administrations where treaties exist. Even on that account a reform of evident convenience ought not to be delayed for consideration of other administrations which are not insensible of the advantages of this innovation, although in theory they hesitate to adopt it; but now, international telegraphic conferences having fallen into disuse, and the term having long expired during the time the last telegraphic treaty was in force, there exists no reason sufficient to stop the application of the reform, and the Spanish telegraphic administration can take the initiative in establishing it without more delay than is necessary for acquainting other states with which treaties have been made, and offering them the consequent and just reciprocity.

The 1st July is fixed for the inauguration of the reform, thus leaving time to make it known to the other nations, and that those may prepare the necessary alterations in their correspondence with Spanish stations. These alterations will leave in force all that is essential in each state, the general basis of correspondence and tariffs.

Unfortunately, there does not exist uniformity of payments of despatches already agreed between France and Spain; there are still nations which keep up telegraphic zones for their tariffs, a system which it would be well to abolish entirely. The Spanish administration will endeavour, as far as possible, by the means which appear most efficacious, that another system should be adopted; but as it is essential with each state to retain or reject it, all future eventualities must be guarded against, not to lose sight of the reform which on its part it establishes, and has made payment by stamps applicable even to correspondence payable by zones, as much as a guarantee and precaution against future persistence in that system, and as a preventive against falling back from the reform, whilst negotiations to render it effective with all other nations are still pending.

This determination demands a declaration which may be transitory, but indispensable, whilst tariffs by zones still exist, that is to put a limit to the fractional charge of telegrams, in order not to increase indefinitely the classes and prices of stamps. For this object, the minimum price of a real has been fixed to cover the excess of cost, which in some telegrams must be paid for any fraction of a real that may be payable. That is to say, as as equity demands a perfect reciprocity be established, not only in the restrictions, but also in the advantages respecting existing arrangements with other states having telegraphic relations with Spain.

Such are, Madam, the objects and basis of the proposed decree, which the Minister who now subscribes has the honour to submit to your Majesty's approbation. If your Majesty deign to grant it, the government will study the means of completing the reform, which is carrying out with other projects of known utility, directed not only to improve the conditions of the lines, but suppress abuses that now disturb much of the correspondence, giving at last to the telegraphic system the organization its importance demands.

Madam, to the R.F. of your Majesty,

ANTONIO CANOVAS DEL CASTILLO.

Aranjuez, 22nd May, 1864.

ROYAL DECREE.

In conformity with what the Minister of State has proposed to me, I have decreed as follows:—

Art. 1. The payment of inland as well as international telegraphic correspondence will be effected through certified stamps, the form and cost of which will be announced in due time.

Art. 2. The texts, which require transmission, can be written on any kind of paper, and presented in the station by any person whatever, or remitted per post, or any other way from any remote part, will be forwarded by the stations, provided they are in accordance with existing regulations respecting their contents and composition, and attached to them the corresponding stamp or stamps to their dimensions, according to tariff.

Art. 3. No despatch whatever will be delivered out of the radius of the locality wherein the station addressed to is situated through any other means than by post; and to forward it through that channel the text which is to be directed must be accompanied not only with the stamps corresponding to the certified telegraph, but also with those of the certified postage from the post office.

Art. 4. The telegrams addressed to localities where there is no station, will be delivered by the last telegraphic office to the post, which will undertake to convey them to their destination as certified parcels, without requiring the seals of the post office. These seals will be delivered to the corresponding post offices by the telegraphic offices that issues them under invoice, and after having been cancelled in the places and districts appointed with the consent of the head departments of both branches.

Art. 5. The seals of all kinds that accompany the despatches as payment of the service of transmission and delivery, will be cancelled at the station that sends them at the time of depositing them in it.

Art. 6. When one sole text is to be addressed to various persons in the same locality, it will be considered for payment as many despatches as individuals pointed in it.

Art. 7. The acknowledgment of the receipt of each telegram will be counted for payment as a new despatch.

Art. 8. Payment will be admitted previous to the return of the answer of the telegrams, effecting it with certified stamps, in accordance with the type specified for answers. These seals will be cancelled as the rest by the station who sends them. If the answer is not returned, or if it should contain less words than those paid for, no return of any kind will be made. If the answer is more extensive than the certified one, the station which sends it will recover in seals the difference between the amount paid and the corresponding one to this new despatch.

Art. 9. When the person who sends the message wishes to certify it, he will use for that object, independent of the corresponding ordinary stamp or stamps to the text, the special seal of certified telegraph. The station that sends it remains answerable to hold at the disposal of the party signing each certified telegram, the channel conveyed until it reaches its destination, and an acknowledgment of its delivery. The certified telegrams will have no preference of turn for transmission.

Art. 10. The private claims for delay or irregularity of telegrams will only give occasion for future enquiry into the causes which have produced the irregularity in the service, for the knowledge of the interested party, and to punish the functionary or functionaries who might result culpable.

Art. 11. In no case the identification of the sender of the message will be required, though he may offer it or if any one should claim it.

Art. 12. The managers of post offices, in localities wherein railway stations and government telegraphs exist will make special separation of the parcels for the telegraphic service, so as to be delivered instantly to the telegraph stations after the arrival of each train.

Art. 13. The same telegraphic tariff will regulate the inland correspondence and that of the Balearic Islands.

Art. 14. The general administration of the branch will give immediate cognizance to the managers of the different states bound to Spain by telegraphic treaties, of that part of the preceding arrangements which will cause alterations in the present form of the correspondence between the different countries, and will endeavour by all means which it may consider convenient to harmonize the international telegraphic service.

Art. 15. The same administration will put itself in communication with the administration in Portugal, to establish an uniform tariff between the nations, and will invite at once the other nations to suppress the telegraphic zones.

Art. 16. The accounts for the international correspondence will be carried as at present, but the liquidations and balances that may result, the General Administration of Telegraphs will acquaint the Finance Minister, so that he may dispose of those funds as he thinks proper.

Art. 17. In the meantime that the uniformity in the tariffs amongst the different states united by telegraphic correspondence is in abeyance, that which is sent from Spain to the nations still preserving their tariffs per zones, the amount will be collected as it is agreed, but in certified stamps and in entire reals, counting as a real every fraction of a real which may result in the rate of every despatch.

Art. 18. The Minister of State will enter into an arrangement with the Exchequer to decide upon the issuing and convenient cost of the special telegraphic stamps, and will adopt such measures as he may consider necessary to carry out what is ordered in the preceding articles.

Art. 19. The General Board of Telegraphs will immediately adopt the necessary measures, so that from the 1st of July the preceding resolutions may be carried out.

Art. 20. All the measures in opposition to these presents are therefore annulled.

Given at Aranjuez, on the 22nd May, 1864.

I THE QUEEN.

To the Minister of State for Home Affairs,
Antonio Cánovas del Castillo.

The provincial deputation of Seville, recently invited to take part in the development of the Submarine trans-Atlantic Telegraph which is to unite Europe with America through Portugal, has been found disposed in favour of the project. It is to be hoped that the deputation of Corunna, to which one of the most important and influential telegraphic societies of the capital will soon apply, will also answer the appeal in a noble and generous manner, to assist in carrying into effect the laying down of the cable, to start from Falmouth and terminate in Corunna, putting this nation in direct communication with Spain, freeing themselves from the interference which France exercises at present. The deputation of Corunna, in which we are told are to be found liberal, clever, and independent members, will not only embrace, but will give an impetus to this measure of importance.

One of the weekly scientific meetings of the telegraphic body took place on the 30th of May, at its club in Madrid, and Mr. Felix Garcia Rivero expressed himself in so satisfactory terms upon the submarine telegraph, that he left nothing untouched in his pleasing and honest speech.

Completely recovered from the illness under which he has been suffering of late, Mr. Mathes, an active and clever functionary, has taken charge of the general management of telegraphs in Spain.

ON THE PATENT LAWS.

(*Continued from page* 272.)

The following communications were received by the Secretary of the Society of Arts from members who were unable to attend the discussion on Mr. Webster's valuable paper, and will be perused with interest by many of our readers :—

Mr. HENRY COLE, C.B., writes as follows :—

At the adjourned meeting of the Society to discuss the Patent Laws, I request that you will have the kindness to read this letter as a substitute for my presence. I feel it somewhat of a duty not to be silent, having taken an active part years ago in promoting the reform of the Patent Laws upon the principle sanctioned by a Committee of the Society, whose three published reports I was entrusted to prepare.

In 1849 a numerous Committee of noblemen and gentlemen* was appointed by the Society to promote "Legislative Recognition of the Rights of Inventors." The opening paragraph of the first report of that Committee was as follows :—

1. A British subject has no rights of property whatever in that intellectual labour which produces invention or scientific discovery, excepting such as he can obtain by petition from the Crown. He may have bestowed years of mental exertion and manual toil in perfecting a discovery most beneficial to mankind, still he is not in the position of being able to claim even the recognition of the fruits of his labour as his own. He must become a petitioner for the right to the Crown, which is absolute and irresponsible, and may refuse it without any power whatever of appeal. Many and well-settled as are the rights of British subjects compared with those of other nations, the suppliant inventor has no rights of his own in his invention.† The inventor in France, in America, in Holland, and in Belgium, even in Austria and Spain, has his rights recognised by declared law; but the Englishman has none. By passing through a series of formulas, so antiquated that the origin of them is lost in the obscurity of past centuries—so empty and frivolous that common sense revolts at them—so numerous that they can hardly be reckoned accurately—so intricate that every one seems a pitfall to discourage scientific invention to the utmost—so inexplicable that the greatest diversity of opinion obtains in interpreting them—so costly as to place scientific intelligence wholly within the power of capital; an inventor may at last obtain a mere recognition of his right, which he is then at liberty to protect as he may be best able.

2. This Committee brought before the public, for the first time, a recital of the thirty-five stages which it was necessary, at a cost of about £100 in fees only for England, to pass through to obtain a patent; and Mr. Charles Dickens, in a most humourous paper, entitled "A Poor Man's Tale of a Patent," in his *Household Words*, described how one Thomas Joy had

* The Committee consisted of the following:—The Marquis of Northampton; the Earl of Radnor; Sir John P. Boileau, Bart.; Sir J. J. Guest, Bart., M.P.; the Right Hon. T. Milner Gibson, M.P.; Henry T. Hope, Esq., M.P.; Samuel M. Peto, Esq., M.P.; Sir James Anderson, Glasgow; George Brace, Esq; Henry Cole, Esq.; Charles Dickens, Esq.; J. H. Elliott, Esq; John Farey, Esq., C.E.; P. Le Neve Foster, Esq., M.A.; Charles Fox, Esq., C.E.; Wyndham Harding, Esq, C.E.; Edward Highton, Esq.; Captain Boscawen Ibbetson, K.R.E.; Owen Jones, Esq.; Herbert Minton, Esq., the Potteries; R. S. Newall, Esq., Gateshead; Dr. Lyon Playfair, F.R.S.; Richard Prosser, Esq, Birmingham; Dr. J. Forbes Royle, F.R.S.; W. W. Rundell, Esq., Falmouth; Archibald Slate, Esq, Woodside, Dudley; J. Jobson Smith, Esq, Sheffield; Professor Edward Solly, F.R.S.; Robert Sutcliffe, Esq., Idle, Leeds; John Sylvester, Esq.; Arthur Symonds, Esq; Professor Bennet, Woodcroft. Secretary, George Grove, Esq.

† "There is not any clause or enactment by which the subject can demand them as a right. This great encouragement to industry, this fruitful source of wealth, is still the free gift of the Sovereign. It emanated from Her Majesty, as the patron of the arts and sciences, at the humble request of her subjects; and it is as a gracious favour that she extends this royal protection to the inventor."—*Godson on Patents*, p. 21.

perfected a model, and wanted to patent it; came to London; petitioned Queen Victoria; declared before a Master of Chancery; went to the Home Office; got his petition signed by the Home Secretary; took it to the Attorney-General; paid four pound four; "Nobody all through ever thankful for their money, but all uncivil;" back to Home-office; got a warrant; sent to the Queen; Queen sent warrant back; Home Secretary signed again; went to Patent-office for a "Draft of the Queen's Bill" and a "Docket of the Bill;" two copies engrossed, one for Signet-office, one for Privy Seal-office; engrossing, stamping; again to Attorney-General; again to Home-office; again to the Queen; then to the Signet-office; then to Lord Chancellor; then to Privy Seal; then to Clerk of Patents; then fees to Lord Chancellor's Purse-bearer and to Clerk of Hanaper, and to Deputy Clerk of Hanaper; again fees to Lord Chancellor; and lastly, fees to Deputy Sealer and Deputy Chaff Wax! Pleasant processes to numerous interests—law and others. All this rubbish the Society cleared away.

3. The Great Exhibition of 1851 gave a great blow to this antiquated system, and a special Act of Parliament was obtained, which enabled inventors to exhibit without the intervention of Hanapers and Chaffwaxes. Then a Committee of inquiry in the Lords sat, and an Act was passed, based upon many of the most important principles advocated by the Society, and in accordance with the practice more or less adopted by other European countries and the United States. I need not describe them: they are stated in the third report of this Committee.

4. There has now been ten years' experience of this Act, and everybody, without exception, advocates the amendment* of the system; as Mr. R. Wilson said in his excellent and practical speech, "Either improve this system or give up the patents altogether," whilst there is a strong and growing party which desires its repeal and the abolition of patents. A commission, consisting of legislators, lawyers, and others, are investigating what is to be done, and, appropriately enough, the Society again discusses the subject.

5. Certainly the problem is most difficult, and not to be hastily solved. It is easy, if you are convinced, to say, "Away with all patents, and no monopolies; leave manufactures alone and to manage for themselves;" and I confess I find myself inclining more in that direction than towards tinkering at minute administrative legal details.

6. Yet, on the question of principle of patents, I hesitate to say confidently that Adam Smith and Bentham, John Mill and others are in error, and that the practice of other countries is wrong. But the discussions which have taken and are taking place, as well as the experience of the last ten years, make, to my mind, some things in this matter quite clear. I have no interest whatever in any patent. I claim to have been a reformer of the old patent laws. I am not a patent agent or a lawyer, and I think I am quite unprejudiced and dispassionate on this subject.

7. It is clear to me that copyright in authorship or artists' work is quite

* The following were the heads of a Bill recommended by the Society in 1852, and it will be seen that many of the evils now complained of would not have existed had the recommendations been fully adopted:—

Resolutions passed to form the Heads of a Bill.

1. That everything in respect of which a patent may now be granted should be registered.
2. That the benefits afforded by Registration should extend to the United Kingdom of Great Britain and Ireland, and the Channel Islands.
3. That the Registration should be considered merely a record of claims, and not as any determination of rights between parties.
4. That it should be competent to any Inventor to make disclaimers and to rectify errors in his Specification at any period.
5. That Registration of Inventions should be obtainable for a period of one year on payment of £5, and should be renewable for four periods of five years each, on payment of £10 at first renewal; of £20 at second renewal; of £50 at third renewal; and of £100 at fourth renewal. [The principle of renewed payments is proposed as a means of testing whether an invention is in use, and of removing useless inventive rights that might otherwise be obstructive of improvements.]
6. That there should be penalties for using the title of "patent" or "registration" where none has ever existed.
7. That the present tribunals are insufficient for the trial of subjects of design and invention.
8. That it should be permitted to commence actions for infringement of the rights of Inventors in the County Courts.
9. That inasmuch as, contrary to expectation, very little litigation has been created by the rights conferred by the Designs Act of 1842 and 1843, this committee is of opinion that a fair trial should be given to the working of the proposed system of Registration of Inventions before any special tribunal to determine inventive rights is substituted for the existing tribunals.
10. That any tribunal before which proceedings are commenced should have power to refer any case for report and certificate to the Registrar, assisted by competent and scientific persons.
11. That upon the illegality of the Registration being established by the judgment or order of any competent tribunal, the Registration be cancelled.
12. That there should be only one office for the transaction of business connected with the Registration of Inventions, and the payment of fees in respect thereof.
13. That every person desiring to register an Invention should submit two copies of the Specification of his claim, accompanied, in every case where it is possible, by descriptive drawings.
14. That the mode and procedure of Registration should be regulated by the Board of Trade, subject to a report to Parliament.
15. That an annual report of all Specifications registered, with proper indices and calendars, should be laid before Parliament.
16. That a collection of all the Specifications should be made, calendared, and indexed, and deposited for public information in the British Museum.
17. That it is highly desirable that such a collection should be printed and published.
18. That the surplus profits, after paying office expenses and compensation, should be directly applied to some public purpose connected with invention, but not carried to the Consolidated Fund.

distinct from patent right in invention, or the "first finding" of a thing. Minds, however, alike, dwelling on the same thoughts, could never utter them or represent them in the same way identically. Mr. Webster says, "the subject of copyright is one specific combination of words, letters, and lines, in this respect similar or analogous to the specific combination constituting a machine." The fallacy of this is apparent when we put Shakespeare and his "Hamlet" as "similar or analogous" to W. E. G. and his "Ærial machine," or R. D. and his "Hair brushes rotatory," or W. C.'s "Lubricating apparatus," as registered in the Society's last *Journal*. But inventors seeking to find a something would most probably each one find that identical something at the end of their race. They are like huntsmen—Reynard is there—somewhere—and the first seizes the brush, which the second or third might have got by happy accident.

8. It has been hitherto held to be good public policy that the first finder shall have a limited monopoly of his invention against other seekers and finders, on condition of his honestly making it fully public.

9. Everybody agrees that the finder does all he can not to keep this part of his engagement. His specification is made as dark as possible. Can you compel him to make it clear and definite? Perhaps so, but it is difficult. Perhaps a public registrar might usefully be appointed to determine if the inventor did or did not state in a given form, clearly and unmistakably, what his invention was.

10. I am opposed to Mr. Webster's opinion that "Patents should *not* be granted as of course, but some check be placed on their indiscriminate issue by a preliminary inquiry and report." I don't wish to see a Pope for patents, or any compulsory tribunal attempting to decide if the invention be one or not. I doubt its competency and authority. I am sure it would give little satisfaction, and certainly an appeal against its decision would have to be allowed, which might be good for lawyers, but certainly not for inventors. The onus of the proof of the invention I think must rest solely with the inventor. Like all other possessors of rights, the inventor himself must defend his own if he care for it.

11. One great merit of the existing law is that it extinguishes frivolities. Mr. Hawes has shown that out of 3,000 patents, only 100 sought to exist for seven years. "Only 100 out of 3,000 are worth £100 at the end of two years."

12. If it be determined to maintain the principle of a Patent Law, then the preservation of this principle of successive stages seems to be most important, but I think the time of duration of the right as well as the cost should be greatly reduced.

13. Let the "first finder" or inventor have a right of registering that he claims to be so. Compel him to register his claim as distinctly as possible. Allow of no evasions. Pay a public officer to keep him up to the mark. Allow his claim to stand good for twelve months and no longer. This period, I think, would be sufficient to enable him, not, perhaps, in some few cases, to *perfect* his invention, but to keep a-head in the market of other claimants, and to find, if necessary, the capital to go on with it; for it is generally admitted that the first finder has to find, besides his invention, the capitalist, who works the thing found. As Dr. Collyer said, "Men who had money did not, as a rule, devote themselves to invention."

14. It may be said that so short a period of monopoly is not long enough to attract capital. I don't believe it. Capital will obey the usual laws of self-interest, and it is not requisite that Parliament should give it monopolies or protection. It can take care of itself.

15. It has been proved, I think, that no very great discoveries can be traced to the monopoly granted by the Patent Laws. They go on quite independently of charters or legislative laws and such like artificial conventions. I have arrived at the belief that the progress of inventions, either great or little, would not be arrested in the slightest degree if Patent Laws were abolished. Philosophers don't want the monopoly. Competitors for "first findings" may—and it may be right to give it, although it is admitted that the monopolies granted lead incidentally to great nuisances, undoubtedly hindering other competitors.

16. The question resolves itself to this: Is it right public policy to encourage first finders or inventors to hunt for things, to register publicly such findings, and, in return for such public registration, to acknowledge their claims to a right to the "first find" for a very limited time? and I come to the conclusion that under present circumstances it is. Such policy may lead to the abolition of even the very limited monopoly proposed. If it do, it will be an easy transition—better, I conceive, than a violent and absolute revolution, like the total abolition of patents. If it do not, then the limited monopoly will remain, in accordance with public convictions of its public utility, but very limited in duration. The right of monopoly should, I think, be obtained easily, and at a cost sufficient and no more to pay the expenses of a proper registration. Experience has shown that the present fees are merely a tax, which has not even yet been applied to erecting a creditable Patent Library or Museum for Inventions, things of great value and public interest apart from the policy of patents.

(*To be continued.*)

FRENCH TELEGRAMS.—It is announced that on and after the 1st July next, the rates for telegrams between France and Bavaria will be from 3f. upwards.

THE AMERICAN PATENT COMMISSIONER ON THE POLICY OF PATENTS.

(*Continued from page 274.*)

I NOW recur to the first and most important question, whether the patent policy has actually increased the industrial resources of nations.

It is grateful to refer to the testimony upon this point given before the committee before referred to by intelligent practical men thoroughly familiar with the operation of the patent laws and the condition of the arts in Great Britain. Mr. Carpmael, a patent agent of great experience, in reply to the question—"Are you of opinion that the present patent law might be safely repealed altogether, and inventions deprived of all privileges of protection?" replies, "I can only say that I can see no inducement to an inventor to come forward to benefit the manufactures of the country, unless you give him some reward. Looking through the history of the whole of the manufactures of this country, you will find that all the steps have been founded upon patents, from the earliest date up to the present time. Take any branch, whether it be the cotton manufacture, the steam-engine, the manufacture of flax or wool—in the case of every one, if we trace the history of it through, which I should be happy to do if it were necessary, it will be seen that the whole system is based upon patents. Paper-making is the same, and so in every branch that I remember."

Being asked, "Can you without difficulty point out a certain number of very important inventions, which were preceded by such costly experiments that they could not have been carried out without the patent law?" Mr. Carpmael says: "Watt, in the case of the steam-engine, was seven years before he got the first engine to work efficiently. In the case of Arkwright's machine for spinning cotton, he was several years before he got efficiently to work. In the case of Crompton the same; in the case of Hargraves the same. Then, in regard to combing wool by machinery, and the first power-loom by Cartwright, he did not succeed in getting practically to work for many years, and he was rewarded by Parliament for what he had done, because he had not been remunerated in the working of his patent. The paper machine was worked out by a series of costly experiments, which never would have been entered upon but for the patent laws of the country. In this manner might I go through all our manufactures; indeed, in no instance has any manufacture grown into importance in this country except by a series of costly experiments and costly machinery, carried on for many years in the hope of deriving benefit through a grant of letters patent."

Mr. Webster, the well-known writer on patent laws, stated before the committee: "I am quite sure of this, that if any person who may be disposed to think that patents should be done away with, comes to examine the way in which particular manufactures have been built up by reason of the large amount of capital which has been thrown into them, in reliance upon the action to be obtained by means of the protection given for a short time, he will be very much surprised. In some of the most successful inventions of the present time, it will be found that the first patent effected little; but, in attempting to work this out, further improvements were made, and fresh patents obtained, so that by the protection which has been given to different stages of the invention, and the quantity of capital which has been laid out upon it, the invention has been perfected and introduced, and made useful to the public in a time within which it never could have been done but for the money which has been employed upon it, in reliance upon the protection of the patent. The whole of our experience of cases before the privy council is proof of that, and leads to the conclusion that many inventions would never have been introduced at all without such protection; and no man, so far as my knowledge of manufactures goes, would have ventured upon those experiments had it not been from some such inducement as the reward offered by the patent law."

Mr. Bennett Woodcroft, the accomplished superintendent of the Great Seal Patent-office in England, under the Commissioners of Patents, to whom more than any other person is due the publication of the specifications and drawings illustrative of all the patents granted in England since 1617—a work which may be justly regarded as one of the proudest monuments of British genius—has added to the many obligations conferred upon this office by presenting to it, within the last year, a series of engravings executed in the highest style of art. Their subjects can be best described in his own words: "Actuated by a sincere respect for mechanical genius, and a warm admiration of its productions, I have collected all the known portraits, eight in number, of the *ten mechanicians* whose inventions laid the foundation, raised the superstructure, and now secure the continuance of the cotton manufacture, the most marvellous for its extent and effects that ever employed the ingenuity of man."

Mr. Woodcroft, in a memoir which he has published containing brief biographies of inventors of machines for the manufacture of textile fabrics, observes that in looking at the progress and magnitude of the cotton manufacture, surprise is excited at the simple construction of the few machines which have produced such wonderful results, "at the lateness of their revelation and their tardy adoption." And he appositely applies to those works the words of Milton:—

> "Th' invention all admired, and each how he
> To be th' inventor missed; so easy it seemed,
> Once found, which, yet unfound, most would have thought impossible."

The ten mechanicians to whose inventions the results produced in the

cotton manufacture are by Mr. Woodcroft mainly attributed are—Kay, who was inspired to run the shuttle on pulleys, and impel it by a short lever attached to a string, by which one weaver was enabled to do the work of two or three; Paul, who taught a method of spinning a hundred or more threads at once; Arkwright, who reinvented and revived roller spinning; Hargraves, who invented the jenny, which drew sixty or seventy threads at once; Crompton, who invented the *mule* (so called because it combined Paul's and Hargrave's inventions); Radcliffe, the author of the improvement in sizing or dressing the whole of the warp before it was wound upon the beam, thus removing the grand difficulty then existing in the art of weaving; Cartwright, who brought forth a loom which would weave cloth by a mechanical, instead of a manual motor, and thus quadruple the power of the weaver; Jacquard, who invented the apparatus to which his name is given for selecting the warp threads, which superseded the service of the draw-boy at the loom; Roberts, who made the mule of Crompton automatic, or self-acting; and Heilmann, who, from observing his daughters comb their hair, conceived the machine for combing cotton and wool, ever since in universal adoption.

Mr. Woodcroft thus states the result in Great Britain alone, produced mainly, as he considers, by these ten inventions:—In 1760, at the accession of George III., the entire value of cotton goods manufactured in England was about £200,000 a-year. In 1772 British calicoes were made to the number of 50,000 pieces. In 1816 upwards of 1,000,000 pieces were manufactured. In 1750 the population engaged in the cotton manufacture was about 20,000. In 1801 the persons engaged were about 80,000. In 1823 there were 10,000 steam-looms in Great Britain. In 1862 their number was 399,992, driven with a power of 294,000 horses, and employing 451,000 workpeople in 2,887 factories, containing 30,387,457 spindles. Every one of the ten inventions which have produced these marvellous results was protected by patents; each inventor was stimulated by the reward which this protection opened to his hope, if not his fruition, and, without the prospect of appropriating to himself wealth and honour, would have shrunk from the labours of creating and introducing his invention. Granting, as is quite probable, that the individual importance of these men in relation to the cotton manufacture is somewhat exaggerated, and that the credit given to them should be shared with the eight hundred men who have taken out patents for improvements in this manufacture, it is no less true that the whole system of the manufacture of cotton in Great Britain is founded upon patents.

Illustrations—less striking it may be, but not less convincing—of the beneficial influences of the protection afforded by patents can be found in the history of the industrial arts in this country. I will point to a totally different branch of manufacture which had its undoubted origin, and has attained its perfection, in the United States—the manufacture of india-rubber goods. The facts are obtained from records in this office and reports of committees in Congress. India-rubber was introduced into France in 1776. Dr. Priestley says, that in 1791 he saw a specimen of the gum at a stationer's, where it was used to erase pencil-marks—hence its name. In 1823 five hundred pairs of shoes, made by the natives in South America directly from the exudations of the gum-bearing tree, were imported into this country, and sold at Boston. In the years 1832, 1833, 1835, and 1836 several manufactories were established in New England for making india-rubber goods.

Upon their introduction into market, it was found that the goods became clammy and sticky when exposed to heat, and were stiffened by the cold. They were, therefore, useless. In consequence of these defects, in 1839 all the companies and individuals engaged in the manufacture were ruined. The manufacture was utterly prostrated. At this time a simple workman in Connecticut, named Hayward, who had undertaken to carry on this manufacture by himself—who, to use his own words, hired the shop he worked in—and whose only income from the uncertain profits of his business was about 500 dols. a-year, sought day and night to discover some substance which might be combined with the india-rubber and cure its defects. Absorbed in the search of what to him was the philosopher's stone, "he dreamed at night," as he asserts, that the desired solvent was sulphur. He combined the rubber with sulphur, and to his delight discovered that the defects in the goods were almost wholly overcome. He had miraculously, as it were, discovered a substance which combined chemically with the rubber, making, in fact, a sulphuret of rubber—indeed, a new substance, whose structure is fibrous like horn, whereas the structure of rubber alone is granular, or molecular. He obtained a patent for his discovery, but being heavily in debt, and perhaps unable to conceive of the vast consequences which would result from his invention, he sold the right to his invention for a mere pittance to Mr. Goodyear. The latter experimented upon the new compound discovered by Hayward, and discovered the art of vulcanizing it. This invention is thus described by Mr. Webster, in his great speech at Trenton:—"The great peculiarity of this vulcanizing process is this: If you take a compound of sulphur and rubber in a dry state and grind and mix them together, and apply heat, the consequence is that the substance softens and softens as the degree of heat increases, until it reaches a certain height in the thermometer, say 212° Fahrenheit and along there, a little more or less. Well, anybody," says Mr. Webster, "who ever tried the effect to see what would be the operation upon this compound, and finding that it ran up to a great degree of heat, softening and rendering it more and more plastic as the degree of heat was augmented, would naturally be of the opinion that if the heat was carried still higher the whole substance would melt. But Mr. Goodyear, as the result of untiring experiment, found out that, although the application of heat produced a melting effect upon this compound, rendering it more and more plastic and soft as the degree of heat augmented, yet when the heat, going on, had got up to a certain much higher degree, its effect was the reverse of what it had been, and then the rubber composition commenced to vulcanize and harden, and in fact to make metallic the vegetable substance." The result of the two inventions is thus stated by Mr. Webster:—"It introduces quite a new material into the manufacture of the arts, that material being nothing less than elastic metal. It is hard like metal, and elastic as pure original gum-elastic. Why, this is as great and momentous a phenomenon occurring to men in the progress of their knowledge, as it would be for a man to show that iron and gold could remain iron and gold, and yet become elastic like india-rubber." Mr. Goodyear obtained a patent for his discovery, and granted licenses to manufacture under his and Hayward's patents. The manufacture at once revived. Twenty years afterwards the yearly sale of goods created by these inventions in the city of Boston alone was set down at 2,500,000 dols. Thousands of operatives are employed in their manufacture. The uses to which the vulcanized rubber is applied are innumerable, and new uses are discovered every day. Waterproof shoes, clothing, tents, pontoons, blankets for soldiers—invaluable as they have been proved in our service, preventing the loss of thousands of lives, and promoting the health and comfort of the soldier to a degree beyond estimation; buckets, life-preservers, mail-bags, car-springs, suspenders, pencil-cases, combs, boxes, are only a few of the countless articles made, specimens of which may be seen in the beautiful collection deposited by Mr. Goodyear in the saloons of this office. There is probably not a family in the country that does not use these goods, and there is hardly an instance on record in which inventions have within so short a period become so essential to general comfort and convenience.

It is unnecessary to say that this great manufacture was founded upon the stimulus which the patent privilege gave to the inventors, and the protection which the patents have given to the manufacturers.

I have spoken of the great spinners and weavers who have carried the cotton manufacture to its great perfection in Great Britain. An invention in the class of textile manufactures has been made by an American, which equals in ingenuity anything which has been accomplished in Great Britain or France. The history of the invention proves that it would not have been introduced without the protection which the patent afforded, and there is precise evidence on record of the saving in money which it has effected for the consumers of the country. Previous to 1842 all three-ply and ingrain carpets were woven in hand looms, the motive power being furnished by the weaver. Numerous and costly experiments to weave ingrain carpets by power-looms had been made in England, but had proved unsuccessful. Mr. Erastus P. Bigelow, of Massachusetts, in 1842, conceived of a series of devices for making the carpet loom automatic, so that the costly labour of men might be dispensed with, and the whole process of weaving might be conducted by girls and boys. After laying his plans before many manufacturers, without obtaining their approval, he succeeded in engaging the attention of the treasurer of a manufacturing company in Lowell, who had the intelligence to see the importance of the undertaking, and to understand the grounds of its probable success. Through him he made an engagement with "the Lowell Company," which, in consideration of the exclusive right to use all his inventions then or afterwards made, so far as they could be applied to the weaving of ingrain carpets, agreed to pay the expenses of putting a trial loom in operation, and if that proved successful, to build a power-loom mill, and to pay Mr. Bigelow a certain patent rent per yard upon all carpeting woven during the existence of the patents which Mr. Bigelow was to take out for his inventions. The trial loom proved successful, and the company proceeded to erect mills to manufacture carpeting under Mr. Bigelow's patents. The cost of these works was many hundred thousand dollars, the fixed capital of the company in their carpet works being $978,956. This vast outlay was made, and in fact the whole improvement was based, upon the protection given by the exclusive right under the patents. The invention was of such a character that it could be developed, tested, perfected, and made practically useful only by the expenditure of a vast capital. The only security for this outlay, which no individual could have made, was the protection of the patent. The company were careful to secure the right to all future improvements which the inventor might make. Encouraged by the certain though moderate reward offered by his arrangement with the company, the inventor continued for four years after the first loom was devised, to add new improvements which were protected by five more patents; and it now presents a machine which is admitted to be unsurpassed by anything which the mechanical genius of man has ever devised. The benefits which this invention has conferred upon the manufacturing company, the inventor, and the public, are precisely shown by records in this office, The "Lowell Company" granted to the "Hartford Carpet Company" a license to use these inventions, the use being confined to these two companies. The profit in the carpet department, in the Lowell Manufacturing Company, from October 31, 1859, to April 30, 1863, was $687,801 41c. The total dividends of the Hartford Carpet Company from January, 1855, to July, 1863, were $1,009,649 50c. The par value of the stock, $100 per share. The market value, $155 to $160 per share.

The total receipts of the inventor from his royalty have been $50,432 12c.

The benefit to the public by this invention is, first, the production of superior goods, the texture of the power-loom carpeting being more uniform, the selvage more even, and the matching of the figures more perfect. The actual saving to consumers is thus calculated:—Prior to the introduction of the power-loom, the Lowell Manufacturing Company paid, as wages for weaving by the hand-loom the description of carpeting known as two-ply, $11\frac{3}{4}$ cents per yard, and for three-ply, 25 cents per yard; whereas, with Bigelow's power-loom, they only pay for weaving the former article, $2\frac{57}{100}$ cents per yard, and for the latter, $2\frac{83}{100}$ cents per yard; thus showing a saving by the power-loom in wages paid for weaving of $9\frac{18}{100}$ cents per yard for two-ply, and $22\frac{17}{100}$ cents per yard for three-ply, being an average of $15\frac{67}{100}$ cents per yard. But the saving in wages is partly neutralized by the more costly repairs of the power-loom machinery, and interest on the larger investment of capital required therefore, so that the average net saving by the power-loom is estimated at ten cents per yard. Accurate returns from the mills of the Lowell and Hartford companies up to April, 1863, show that the number of yards of carpeting woven upon looms was 25,964,185 yards; thus the saving to the people by this invention has been two million five hundred thousand dollars. That the saving in the price of manufacture of carpets has accrued to the consumers is evident from the fact that at the time Mr. Bigelow's invention was introduced the wholesale price of the best quality of two-ply carpeting was from eighty-five to ninety cents per yard, and of three-ply from one dollar and thirty, to one dollar and thirty-three cents per yard; whereas, in 1860, the former description of goods, power-loom wrought, of a better quality than the hand-loom wrought, sold for from seventy to seventy-two and a-half cents per yard, and the latter from ninety-five to ninety-seven and a-half cents per yard, making an average reduction of over twenty per cent. It is worthy of observation that the ingrain carpets are used not so much by the wealthy as the middle classes. They give comfort and attractiveness to the homes of the people, and thus this invention, originated and introduced by the patent policy, has had a sensible effect in ameliorating and refining society.

CORRESPONDENCE.

THE PERSIAN GULF TELEGRAPH CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your journal of the 28th ult. there appeared a most interesting account of the successful telegraphic operations in the Persian Gulf. The whole proceedings appear to have been conducted in the most scientific and systematic manner, from the commencement to the completion thereof, and the greatest credit is due to Lieut.-Col. Stewart, and Sir Charles Bright and his able and experienced staff, for the manner in which they performed the arduous and difficult duties upon which they were engaged, and more especially as these duties had to be performed under considerable disadvantages from the nature and character of the Gulf and its inhospitable shores, and also the remoteness of the scene of their labours from any place where assistance could be obtained in case of accident or failure.

Only one untoward event occurred during the whole operation—the sudden cessation of the continuity in that portion submerged between Bushire and Fao. The cable being laid in comparatively shallow water, not much difficulty was experienced in restoring the communication, but what concerns the public in the matter is what if such a cessation had taken place in deep water, such as the Atlantic for instance, where repairs could not have been effected. The nature of the injury is a singular one, and is thus described:—"*It was found that the wire only was affected, its gutta-percha covering and the outside casing of iron wire, &c., remaining intact.*" Was not the outer iron casing elongated by excessive strain, and thereby breaking the copper conductor, or was the fracture of the copper owing to a defect in quality or in a joint? It is further stated that "*When the steamer came over the exact spot and the broken part of the cable began to be racked off the ground, the electric current began to flow through it again as if it were perfect. This was the result of the bending of the cable as it left the ground, which caused the broken ends of the wire to come again into actual contact.*"

Was it not the result of the release of the cable from overstrain that brought the ends of the wire together, or, in other words, the contractile force of the iron sheathing? As the question is one of the greatest importance with respect to the approaching attempt to submerge an Atlantic cable, I am sure that any further information upon the subject would be thoroughly appreciated by many besides your obedient servant,

June 4th, 1864. ONE INTERESTED IN SUBMARINE TELEGRAPHY.

THE GLOBE TELEGRAPH COMPANY.—The above company's bill for parliamentary powers has passed. It was vigorously opposed by the Universal Private Telegraph Company, but fortunately for telegraphic interests, unsuccessfully. The Wilde instruments are exceedingly ingenious, simple, and effective in their action, and, in our opinion, superior in every respect to those of Wheatstone.

PARLIAMENTARY NEWS.

THE CANADA AND PACIFIC TELEGRAPH.

Mr. S. AYTOUN asked the Secretary of State for the Colonies, if he could say when the returns relative to Customs Duties (Canada), ordered on the 5th of May, and the return relative to the Canada and Pacific Telegraph, ordered on the 10th of May, would be laid upon the table, and what was the reason that there had been so long a delay in doing so.

Mr. CARDWELL said he was sorry for the delay that had occurred in the production of the parliamentary papers, which was owing to the circumstances of their being contained in a large number of different volumes. They were, however, now in the hands of the printers, and he hoped they would be shortly in the hands of hon. members.

TELEGRAPHIC NEWS.

PORT NATAL.—The telegraph line to Maritzburg was being constructed at the date of the departure of the last mail from the Cape, and it was expected that the whole line would be open for business in a few days.

PERSIAN GULF TELEGRAPH.—Col. Stewart telegraphs from Mussendom, under date the 8th ult., that telegraphic communication with Bagdad, viâ Teheran, will be completed very early in July. The land line was completed on the 7th ult. from Bushire to Kaycroon, 100 miles, including the most difficult mountain passes on the whole line.

THE ATLANTIC TELEGRAPH COMPANY.—We had an opportunity a few days ago of testing electrically a portion of the new cable now in course of manufacture at the works of the Telegraph Construction and Maintenance Company, Limited, Wharf-road, City-road. We found its insulating properties to be most satisfactory; indeed, superior to any core which we ever had an opportunity of testing. The arrangements adopted by Mr. Willoughby Smith, the company's electrician, for testing, appeared to us of the most complete character, and every facility was afforded us in our examination of the apparatus and the cable.

THE TELEGRAPH IN SPAIN.—In another portion of these columns will be found some interesting particulars with respect to the opening up of telegraphic communication in Spain. The interest which has ever been manifested by the Minister, Senor Antonio Cánovas del Castillo, in the establishment of a system of telegraphy, and in the development of the resources of his country, is deserving the warmest commendation. It is stated that the Royal Decree authorising the construction of telegraph lines in the interior of the kingdom will take effect on the 1st proximo.

TELEGRAPHY IN BELGIUM.—On the 1st January, 1864, the total length of all the telegraph wires in the possession of the Belgian Government equalled 2,647 kilometres; the number of wires to each line varying from 1 to 15. The length of wire equalled 6,238 kilometres. The number of offices open was 252. There are but five European nations which possess a greater number of offices; these are England, France, Prussia, Italy, and Austria. The Morse system is adopted in 97 offices; in the others the systems of Siemens, Lippens, and Breguet are employed. The state has supplied up to the above date a sum of 1,251,418f. for the construction of these lines, which sum has been thus apportioned:—posts and wires, 857,046f.; apparatus and accessories, 394,372f.

AUSTRALIAN TELEGRAPHS.—The telegraph is being rapidly extended in our Australian colonies. In the month of May, 1863, the following were the number of stations and the length of line open for traffic:—

	Stations.	Miles.
South Australia	30	1,500
Victoria	62	4,300
New South Wales	46	4,700
Queensland	9	240

The number of messages conveyed by these lines last year was 400,000, and the receipts on the same amounted to £80,000. A proposition is before the legislature for a grant of £160,000 to effect a junction with the great Indian line now rapidly approaching completion.

GOVERNMENT APPOINTMENTS ON THE INDIAN TELEGRAPH STAFF.—The following is the list of successful competitors at the examination held at the India Office in the last week in May for appointments in the Indian Telegraph Department:—

MAXIMUM NUMBER OF MARKS, 5,000.

	Name.	Place of Education.	Marks.
1.	Charles H. Ringwood	Trinity College, Dublin	4,209
2.	John M. Scott	" " "	3,898
3.	John C. Douglas	Birkbeck Science School	3,812
4.	George J. R. Leeson	Trinity College, Dublin	3,342
5.	Samuel W. Gerrard	" " "	3,122
6.	Jas. A. Briggs	Birkbeck Science School	2,981
7.	John Burke	Queen's College, Galway	2,632
8.	Edward S. Townsend	Trinity College, Dublin	2,606
9.	Thomas M'Kelvey	Queen's College, Galway	2,453
10.	James J. Dooley	" " "	2,433
11.	Arthur H. Curling	" " "	2,045
12.	Augustus S. Hinds	" " "	2,012

BONELLI'S TELEGRAPH.—At the annual conversazione of the Institution of Civil Engineers, held on Tuesday evening, the 31st ult., Bonelli's printing telegraph was exhibited, and the results attained are thus spoken of by the *Mechanics' Magazine*:—Two of the machines were shown in constant operation; and whatever may be the question of expense, &c., connected with this invention, its working on this occasion left little room to doubt that its action is at once very perfect and very rapid. The printing was legible in the highest degree; the entire apparatus worked without hitch or impediment at a very fast pace, and did not fail to leave a favourable impression on the minds of those who witnessed its performance.

RAILWAYS AND TELEGRAPHS.—At the University soiree, on Wednesday evening, the Silver India-Rubber and Cable Construction Company exhibited a series of samples of material for railway and telegraphic uses. one of the most ingenious models being an apparatus for giving notice of disarrangement of distant signals, which is effected by the means of electricity, and consists of a metallic spring which is so fixed that it shall be in the flame of the signal lamp. The lamp will, in four seconds, vary the temperature of the spring sufficiently to break or complete the circuit, and the change is at once communicated to the station, danger being announced by the ringing of a bell, or other suitable means. The gum, Balata, was also exhibited, and engaged the attention of the numerous scientific gentlemen present.

TELEGRAPHIC COMMUNICATION WITH AMERICA.—A company has recently been started, under the title of the International Ocean Telegraphic Company, which proposes to establish telegraph communication between Europe and America by a route which, it is contended, presents fewer difficulties than those met with in the course taken by the Atlantic Telegraph Company. Mr. W. Rowett, one of the directors of the company, attended at the Underwriters' Rooms at Liverpool recently, to explain the nature of the project. The proposed starting point of the line is Brest; thence it will be carried across the Bay of Biscay to Cape Finisterre; thence to the Azores, touching either at Terceira or Flores; and finally, skirting the southern edge of the great bank of Newfoundland, to St. Pierre, one of the Miquelon group of islands belonging to the French. The whole length of the line will be about 2,300 miles, but the longest section—that between the Azores and Newfoundland—will not be more than 800 miles in extent. The distance across the Bay of Biscay is 360 miles, and from Cape Finisterre to Azores about 780 miles. The deepest point of the route is 3,700 fathoms, and is between the Azores and the Bank. Mr. Rowett produced a specimen of the cable which it is proposed to lay down. The telegraph wire is surrounded with a coating of india-rubber, and this is enclosed within a spiral coil of hemp—a mode which Mr. Rowett maintained possessed great advantages over the outer covering of wire rope by which the Atlantic cable was surrounded. Mr. Rowett explained that the great drawback hitherto in the use of india-rubber as an insulator had been that in the process of manufacture it became mixed with foreign ingredients which were speedily acted upon by the salt water, and the insulation destroyed. Recently, however, a mode had been discovered by which the india-rubber was preserved quite pure, and this would resist the action of the water. It was proposed also to preserve the hempen covering from decay by steeping it in a mixture of which Mr. Rowett was himself the inventor, and a testimonial to the efficacy of which he produced from Admiral Elliott. The weight of the cable proposed to be used was stated to be about 3 cwt. per mile, while that employed by the Atlantic Telegraph Company was between 15 cwt. and 16 cwt. Mr. Rowett expected that a superior cable could be constructed upon this plan for about £150 a-mile, and the cost of the whole line he did not suppose would exceed £400,000. The company has obtained a treaty from the French Government authorising them to construct the line; and the money is only wanting, the capital required being £500,000, which it is proposed to raise by the issue of 25,000 shares of £20 each.

TELEGRAPH TO INDIA.—The following extract from a letter, dated Mussendom, March 25th, 1864, from a gentleman well known in telegraphic circles, will be perused with considerable interest, as it shows somewhat of the vicissitudes encountered in the laying of the Persian Gulf cable:—"Up to the present time Government have been finding us in rations, but that is too good to last long, and I believe we shall soon be on our own hook. As the Arabs were rather troublesome, threatening to do for us, &c., when the steamers were gone, and other little playful traits of character, such as never taking anything out of their reach, &c., we were all moved off the neck of land we were first encamped on, and came off to this little island, which is to be the permanent station. We were going to a place about seven miles off, but the natives are not over polite to us there I understand; so, as the clown says, here we are. The two hulks are arrived, but are not very convenient to live in, so we don't use them, and a gun-boat is moored close by. We shall have one of her Majesty's sloops up here soon to replace it. A large wooden house is being built for us in Bombay, and when it arrives I think it will be more comfortable, although since I left England I have not slept more than a dozen nights in a bed-room, and don't dislike tents at all. Two magnetics out of three have been made superintendents. I have charge of the testing these two sections of cable; in fact they were short of electricians, and I came in very handy. From the time I left the old Company I worked very hard indeed to obtain the necessary experience. Time has proved I was right in sticking to it. T—— is here. G—— is at this moment at Bushire, but I think goes on to Fao, near Bussorah. I was not able to go off to the steamer he was in, although she lay within a quarter of a mile, and therefore have not seen him. I spoke to him while they were paying out. The Government have kindly furnished us with rifles for the protection of their property; and I have my own, which shoots very well, and at present a very nice little revolver, which lays on the table of a night. This island is about 100 yards long and 60 broad, rough and stormy; no water or vegetation to speak of; in the middle of a bay about two miles or more broad. The inlet is six miles deep. The shores of the bay are composed of enormous precipitous rocks, quite barren, and which in the hot season will reflect the heat down almost perpendicular—'rather hot that.' Fish is cheap, but fresh meat scarce: we have some to-morrow, being Sunday. I have had no things washed for three months, but they have sent us a Dhobee, and I am in hopes to get some clean things in a few days. At present the climate agrees with me, and has done so very well hitherto, with exception of thirty hours, during which I had something very much like cholera—vomiting, cramps, &c. This was in Bombay, where we staid two months. From the time we left England to the time I came ashore here, I may say I never lived better in my life—almost too well for this climate. I had a very fine time of it coming overland, but I did not see F——; he had been removed to Benghazi. I liked Cairo very much; and I must not forget to mention that I was perfectly delighted with Paris. London isn't a patch on it, or at least in comparison it would be a very dirty patch. When you reply tell me all the *on dits* in the world of telegraphs, what new cables are in contemplation, who has the contract, and who are the head men, especially any Government ones, and the Australian extension line."

THE TELEGRAPH AT THE CAPE.—By the last mail we have a few particulars of the opening of the Cape of Good Hope Electric Telegraph, which extends in an unbroken line for more than six hundred miles, viz., from Cape Town to Graham's Town. It has been constructed under the engineering direction of Mr. Wollaston, by Mr. Hoeltzer, of the firm of Siemens & Co., for the Cape of Good Hope Telegraph Company; and in its substantiality and completeness is all that could have been wished for. The wire is of the best No. 6; the insulators are iron-clad, and perfect of their kind; the poles are stout, tall, and of the most substantial colonial woods; and the insulation throughout is so perfect that no more than fifteen cells of Daniell's batteries are required for working the transmission with ease the whole way from one terminus to the other. The instruments employed at all the stations are a beautiful modification of Morse's printing telegraph, in which the mechanism prints off the various messages, not by indents, but *in ink*, with a distinctness and fixedness which for present accuracy and future reference can leave nothing to be desired. On the arrival of the Saxon with the English mails, the news brought by her was telegraphed to Graham's Town and printed and published there—six hundred miles away—within fifty minutes of her anchoring in Table Bay. Profitable strokes of business have already been made by merchants speculating with frontier markets; and the Government have, equally with private individuals, experienced the vast benefits conferred by this new and great improvement. The only objection yet alleged against it has come from some extreme Eastern traders, who, naturally enough, feel apprehensive that it will for ever drown any faint hope they might have heretofore cherished of getting the seat of Government removed from Cape Town to the frontier. Stationed in Cape Town, the Governor can receive his home despatches four days earlier than he could possibly obtain them at Graham's Town; while, whatever instructions they may contain affecting frontier politics, can be flashed on by telegraph a few minutes after they have been perused in Government House. So great are the advantages derivable from this telegraph already constructed, that is is certain efforts will be made in the next session of parliament to secure its gradual extension, not only over the colony, but in a net-work of intercommunication throughout the whole of Southern Africa.

THE INDIAN TELEGRAPH.—The following remarks and correspondence appeared in *The Times* of the 9th instant:—Annexed is a communication on the Indian Telegraph question, and the present state of that portion of the line which is interrupted from the hostility of the Arabs to the Turkish Government, an evil which would have been obviated, if attention had been paid to the warnings of those who were the first to call attention to the advantages of the Euphrates route:—"Sir,—I was gratified by seeing in a late number of *The Times* an allusion to the accuracy of the predictions of Mr. Andrew regarding telegraphic communication with India, for I feel, in common with many others in the city, that England can never be in efficient telegraphic communication with India until, not only the route recommended by Mr. Andrew is carried out by the Euphrates and Persian Gulf, but until the advice of that gentlemen is followed of having the line from Constantinople to India in the hands of Englishmen. This can only be accomplished by a firm or company farming the line from Constantinople to Bagdad, which, under Turkish management, is almost, if not entirely, useless. A break has, as you state, occurred in the route from Bagdad to Constantinople, 'where the route is so wretchedly looked after, and the Turks are so slow about repairs, that it is impossible to say when it will be again in working order.' It was the wish of Mr. Andrew, who advocated so strenuously in your columns the telegraph by the Euphrates and Persian Gulf, that his company should be intrusted with the construction of the line which they projected, or that they should be allowed to farm the line for the British and Turkish Governments. He knew well enough that the Turkish Government would never manage a telegraph themselves, and that their pride would not allow

our Government to do it for them; and that the Arabs, through whose country it would pass, would not protect the line for the Turks as they would for us, whom they regard as their friends and protectors. Mr. Bidder, not long ago, in *The Times* pointed out what a mess our Government would make of the Persian Gulf cable, keeping it on their own hands, and events are confirming this opinion. Let common justice be done at last, and let those who predicted the failure of the Red Sea route and the feasibility of the Euphrates route be entrusted with the management of the plan they projected when events are proving that their advice was sound, not only as to route, but as to management. We have thrown a million of money away already by taking the wrong route—are we to throw another million away by persisting in a wrong system of management? I am, &c., A MERCHANT."

MISCELLANEA.

THE CURRENT METALS.—Compositions of zinc and copper can be made so hard that they will cut steel, and stand well for tools.

AMPERE AND THE ELECTRIC TELEGRAPH.—In the year 1820 Ampere predicted the possibility of making the deflection of the magnetic needle, by the agency of the galvanic fluid, serve the purpose of transmitting intelligence. In page 19 of his Memoir, he thus resolves the problem:—"As many magnetic needles as there are letters of the alphabet, which may be made to communicate successfully with the battery by the means of keys, which may be pressed down at pleasure, might give place to a telegraphic correspondence which would surmount all distance and would be as prompt as writing speech to transmit thought."

DAMAGE TO A CHURCH BY LIGHTNING.—During the thunderstorm at Llanellian, Denbighshire, on Friday, the 27th ult., the electric fluid entered the church at the top of two of the arches of a three-light window, in the north chancel, having burnt two holes through the lead at the apex of the arches. It knocked out some of the oak pannelling of the chancel, scattering it about the church; it then passed to the roof, scorching and blackening the gilding of the chancel arch, and passed out at the top of the gable, shattering the wall, which was about a yard thick, and raising some of the coping. It may be interesting to some of our readers to know in this instance what a strong resistance was offered to the electric fluid by the glass in the building. The lightning struck the outer wall in several places about the window and forced a passage for itself through a small hole in the leads, but at the same time divided and separated the strong stone mullioned arch at the top and some strong stone-work above the glass, without breaking a single pane of the window.

COATING IRON WITH ALUMINIUM.—Mr. Wm. Clark has invented a peculiar process for covering the surface of iron with a layer of the above metal. The surface of the iron is first cleansed; a mixture is then made of porcelain-clay, feldspar, and white lead, properly ground and incorporated; then about ten parts of this combination are added to about five pounds of calcined and powered alum-clay. This last mixture having been made into a thin paste, and poured over the surface of the metal, the latter is dried and placed in a reverberatory furnace until it presents a glazed appearance. When the iron is removed it will be found to have received a tough, adhesive, and elastic coating, which is so closely attached to the metal that, when this is bent even at right angles, no symptoms of cracking appear. This coating is also unacted on by acids and alkalies. It is supposed that during the baking process the aluminium is separated from its oxide, and forms a thin metallic stratum, intermediate between the iron and the glazed surface.

THE CHEMICAL ACTION OF SEA WATER ON METALS.—At a recent meeting of the Institute of Technology, in New York, a gentleman, well known in the American shipping interests, presented some fragments of a cast-iron propeller, which was attached to a coppered ship, which was remarkably deteriorated. To use the gentleman's own words:—"It had the consistence of graphite, and could be shaved off with a pocket-knife to a depth of $\frac{1}{4}$ of an inch from the surface." Several reasons were given for this rapid deterioration (the screw having been in the water but a few months), but the right one perhaps was not hit upon. It is well known that a piece of iron in a salt of copper will precipitate all the copper in a metallic state, and a corresponding equivalent of iron will take its place in the solution, forming thus a salt of iron. Now might not this reaction have taken place in the case of this propeller? Sea water contains soluble sulphates. The coppering of the ship was probably dissolved in the form of a sulphate, and the iron of the screw being brought into contact with this solution, the copper was precipitated and the iron was dissolved, the crust on the casting which was found to be so soft, was then composed of the oxide of iron [Fe_2O_3] probably, together with the carbon of the cast iron which was left after the iron had been dissolved; and this carbon, which is in fact graphite or black-lead, mixed with the oxide of iron, was the substance forming the crust, which could be so easily cut with the knife. If this reason should be the right one, it would be quite out of the question, practically, to use cast iron propellers on coppered ships unless they could be covered with some pigment which would preclude the possibility of contact between the iron and the salt of copper supposed to be in solution in the water.

TO BLEACH GUTTA-PERCHA.—Dissolve gutta-percha (one part) in 20 parts of hot benzole, shake the solution with one-tenth part of freshly-calcined plaster, and set aside, with occasional agitation, for two days. The clear pale brownish-yellow liquid is then decanted into another vessel containing double its bulk of alcohol fortius, when the gutta will be precipitated in the form of a brilliantly white tenacious mass.

ARTIFICIAL DIAMONDS.—An ingenious Frenchman is said to have "taken out a patent for making diamonds" at Washington. "With two bushels of charcoal he can make a diamond that will weigh a pound." Does he expect his patented process to be perused and not imitated? The "patent" is rather suspicious: the discoverer of the way to make artificial diamonds is not at all likely to take out a patent for it. The improbability of making diamonds is not so great, however, as many, even chemists, may imagine. Indeed, a French chemist is said to have already produced very small ones by fusing carbon with the aid of borax. All that would be requisite to produce diamonds of large size would be the discovery of a solvent of carbon; and the alchymists were said to have possessed such a solvent and tincture. Just as alum dissolved in water can be made to crystalline into alum baskets, so might carbon, if it could only be dissolved in some fitting menstrum, be made to crystallise into abundance of diamonds. Carbon, to be sure, is regarded as an element, while alum is a compound; but it was Davy's opinion that diamond, too, was a compound, and not mere carbon, but probably carbon in combination with some slight tinge or tincture of halogenous material in it. Now, it is a curious circumstance that the alchymical accredited solvent of carbon, or diamond-producer, was called the hyle (or halogen) of the sages, and the elixir of the stone. Doubtful, however, as the alchymical diamond-producer may have been, we are inclined to regard the Frenchman and his patent as no less apocryphal.

BLASTING BY ELECTRICITY.—The following account describes an apparatus used for blasting purposes by the engineer corps of the Philadelphia and Manayunk railroad in some operations on that line:—"The battery consisted of about 25 copper cells, 1 foot long by 18 inches deep, by 1 inch wide, open at top and bottom; these were set in a wooden frame, and separated from each other by common window glass, which was also secured in the frame; inside of each of these cells was a plate of zinc, just large enough to allow a slip of grooved wood to hold it away from the copper at the ends. Each zinc plate was connected to the copper cell next to the one in which it was placed, making thus a very large voltaic pile. From each end of this battery an insulated wire ran to the holes to be fired; that from one extremity, of course, going from the copper, and the other from a zinc plate. The acid used was sulphuric, diluted in about thirty times its quantity of water. The frame was arranged to raise and lower into a wooden trough or bath, which contained the diluted acid, by a windlass, so that the person who was engaged in connecting the main wires to those in the holes, did his work without any risk of an explosion, the battery not being lowered into the acid until he was at a safe distance. For firing the holes, two wires were taken and twisted together. At first it was thought necessary that both should be insulated, but it was soon found that if one of them was coated with gutta-percha, it was sufficient. At the end inserted into the holes these wires were separated about a quarter of an inch, and connected by a very thin piece of platinum wire; afterwards it was found that steel answered every purpose, and was much less expensive. This thin wire melted as the charge of electricity passed through it. At the commencement of the work this was inserted directly into the blasting powder, but two great disadvantages arose therefrom—first, the danger of the small wire becoming broken in tamping the hole; and, second, the difficulty of igniting the coarse blasting powder by the instantaneous spark of electricity; to avoid both of which a small paper bag, large enough to hold about a gunshot charge, was placed over the end and filled with rifle powder, the bottom being pasted, shut, and the top tied securely above the steel wire. Another difficulty then arose from the fact that in handling 'cartridges,' as they were called, the fine powder was frequently unavoidably shaken out of them. This the men who had charge of the holes soon discovered, and before inserting one, would finger the little paper bag to see if it was full, and, as their hands were generally wet, injured the powder. To avoid this, gutta-percha was dissolved in ether, and the cartridge dipped into it; and as soon as taken out of the mixture the volatile liquid evaporated, leaving a very thin coating of gutta-percha over the paper. Thus perfected, the 'cartridge' was inserted into about the centre of the charge of blasting powder in the hole, the opposite ends of the wire protruding; tamping was put in exactly as if fuse were used instead of wires. Before firing, a number of holes were connected together, by taking the protruding end of one wire of the first hole and twisting it to the end of the second, the remaining one of the second to one of the third, and so on. One of the main wires from the battery was then connected with the end of the first wire of this 'batch,' and the other to the end of the last; the battery was then immersed in the bath containing the acid, and the discharge of the whole lot was instantaneous and simultaneous. As many as twenty holes were frequently fired in one lot. The working of this arrangement was eminently successful. For three months an average of nearly a hundred holes a day were fired at each tunnel without a single accident, so far as the blasting was concerned. This system is almost identical with the one invented in France. Many of the details, such as coating the bag with gutta-percha, &c., will be indicated by local circumstances to practical minds."

THE MANIA FOR JOINT-STOCK COMPANIES.—Some national follies have a certain periodicity. You may expect to see them again about every twenty years—after an interval just long enough to allow some full-grown children, who have burnt their fingers, to forget the smart, and others to grow up who don't yet dread the fire. Just such a periodical folly is a Joint-Stock Company mania. It is founded partly on that impatience of low interest which culminates in rashness, and yet more on the gambling propensities of human nature—propensities so rife, that if you can once disguise the vulgar iniquities of the gaming-table, and deal with scrip instead of cards, there is no party within the church, and no denomination out of it, so strict in their horror of all greed and worldliness, but "feeling it their duty to exert themselves for the good of their family," will stake ten times as much with stock or shares as the worst gamester of their acquaintance ever risked at rouge-et-noir.

THE VIBRATIONS OF ATOMS.—In the world of science, while one large class of learned and intellectual men are devoting their labour to the examination of bodies and systems of matter so vast and so remote that the mind is overwhelmed in efforts to conceive the sizes and the distances, another class are engaged in the study of the structure and habits of that innumerable multitude of organized beings which are individually so small as to be wholly invisible to the naked eye; and a third class are directing their thoughts to the size, the weight, the form, and the movements of the still smaller ultimate atoms of matter, which cannot be seen even with the aid of the most powerful compound microscope. Among the most zealous of the last-named class is John Tyndal, Esq., F.R.S., Professor of Natural Philosophy at the Royal Institution. Tyndal espouses the theory that all space is filled with a subtle ether, and that light, heat, and the other imponderable forces are vibrations of this ether, each force being a vibration peculiar to itself. Where heat is produced by burning hydrogen, Tyndal says that the atom of hydrogen is drawn or propelled against the atom of oxygen with a velocity and force that produces a vibration, and that this vibration being imparted to the surrounding ether, affects our senses as heat. If the collision produces vibrations shorter and quicker, these are perceptible as light. At a recent meeting of the Royal Institution of Great Britain, H.R.H. the Prince of Wales, Vice-Patron, in the chair, Mr. Tyndal read a paper on molecular physics, from which we extract the following explanation of transparency:—"What, then, is the physical meaning of opacity and transparency as regards light and radiant heat? The luminous rays of the spectrum differ from the non-luminous ones simply in period. The sensation of light is excited by waves of ether shorter and more quickly recurrent than those which fall beyond the extreme red. But why should iodine stop the former and allow the latter to pass? The answer to this question no doubt is that the intercepted waves are those whose periods of recurrence coincide with the periods of oscillation possible to the atoms of the dissolved iodine. The elastic forces which separated these atoms are such as to compel them to vibrate in definite periods, and, when these periods synchronize with those of the etheral waves, the latter are absorbed. Briefly defined, then, transparency in liquids as well as in gases is synonymous with discord, while opacity is synonymous with accord between the periods of the waves of ether and those of the molecules of the body on which they impinge. All ordinary transparent and colourless substances owe their transparency to the discord which exists between the oscillating periods of their molecule and those of the waves of the whole visible spectrum. The general discord of the vibrating periods of the molecules of compound bodies with the light-giving waves of the spectrum may be inferred from the prevalence of the property of transparency in compounds, while their greater harmony with the extra-red periods is to be inferred from their opacity to the extra-red rays. Water illustrates this transparency and opacity in the most striking manner. It is highly transparent to the luminous rays, which demonstrates the incompetency of its molecules to oscillate in the periods which excite vision. It is as highly opaque to the extra-red undulations, which proves the synchronism of its periods with those of the longer waves."

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1345. P. Deeley, a new or improved machine for testing the strength of wire.

1386. W. Clark, improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power.—A communication.

1405. W. H. Preece, improved domestic telegraphic apparatus.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1234. W. Reid, improvements in apparatus used for testing the insulation of electric telegraph wires or conductors.

1258. J. Webster, improvements in the manufacture of zinc.

NOTICES TO PROCEED.

1242. J. Hamilton, jun., improvements in electric telegraph posts.

PATENTS SEALED.

3116. G. T. Bousfield, improvements in the manufacture of india-rubber and gutta-percha compounds.—A communication.

PATENTS WHICH HAVE BECOME VOID.

1322. E. H. C. Monckton, improvements in obtaining and applying magnetic motive power, which invention is also applicable to other useful purposes.

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100	British and Irish Magnetic, A.	all	57 to 62	—
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100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—

TO CORRESPONDENTS.

Y. I.—Every attempt made at our request to make a sound joint in a core formed with virgin or unmasticated rubber resulted in failure. We shall in a future number give the tests to which an india-rubber core was subjected in one mile lengths, and the test to which the same core was subjected when joined up.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not neccessarily for insertion.

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THE TELEGRAPHIC JOURNAL.

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THE APPOINTMENTS ON THE TELEGRAPH STAFF OF INDIA.

THERE is a great difference between having something to say, and having to say something upon a given subject. The heading to this column will indicate the matter on which we desire to say a few words; our object being not to disturb the quiet of "the yesterdays," but rather to enforce a lesson taught by experience, now that we see how *inutile* have been our previous efforts to incite young men engaged in telegraphy to a study of those branches of science by which alone they will be enabled to advance in their profession.

It will not be out of place, perhaps, if we briefly revert to the proceedings at the India Office with respect to the recent competition. According to announcement there were twenty-five appointments at the disposal of the Under-Secretary of State for India. Numerous were the applications for these offices, but the examiners were only enabled to select twelve candidates as possessing the necessary qualifications. The requirements will be found fully set forth in No. 3, page 33, of this journal; and the few applicants able to attain the specified number of marks fully corroborates an opinion long since expressed in these pages, viz., that the educational requirements were totally beyond the necessities or possible exigencies of the service, and would deter practical men from the examinations. Of the successful candidates, five were tutored at Queen's College, Galway; five at Trinity College, Dublin; and the remaining two at the Birkbeck School of Science. It is very proper that the India Board should require gentlemen of education to occupy the responsible positions in the telegraph department of the country under their direction; it is equally desirable that said officers should be competent to undertake the duties of telegraphists. This latter feature seems to have been entirely overlooked in the recent appointments; and we presume that it will be in India as is too often the case in Government offices at home, gentlemen of education will be placed in office at large salaries to see that men of intelligence do the work of the department for small wages. "It is strange, passing strange" that nearly all the successful candidates are, or have been Irish University men. We do not suppose that any undue influence has been exerted upon the examiners, as it is far more reasonable to conclude that the inducements to English University men were not considered very attractive. For this reason we are led to question the wisdom, yea, the propriety of a competitive examination on an educational basis for appointments where professional skill is of more importance than classic lore.

There are hundreds of young men engaged in telegraphy possessing a good sound English education; an acquaintance with foreign languages (a qualification which appears to have escaped attention in the recent tests); a thorough knowledge of the art in which they are engaged; and who have a very useful additional recommendation in the possession of common sense. These men would have been valuable additions to the staff of the India Telegraph Department, but they have been excluded by the utter unreasonableness of the conditions imposed. However, the appointments for the year 1864 have been made—they are of the past; but we hope that the authorities will profit by our recommendations in the future, and that we shall be able next year to chronicle the admission of practical telegraphists into the service of the India Government. We do not hesitate to affirm that there are gentlemen now deservedly occupying the most exalted positions in the India Telegraph Department (esteemed alike for their many virtues and scientific attainments) who would miserably fail to pass the set curriculum. Therefore we urge the removal of obstacles which only tend to impair the efficiency of the India telegraph staff. If ever the telegraph is to become the medium for correspondence between England and her Indian possessions, practical men must be appointed to the administration in place of collegians who have probably never seen a Morse instrument since they were ushered into existence. The qualifications for appointment on the telegraph staff of any foreign country are easily indicated when the locality of service is determined. Beyond the education which it is presumed every candidate would possess, a knowledge of languages, of meteorological phenomena, of applied chemistry, and of the art of telegraphy is all that is really required to make efficient officers. It could hardly be expected that telegraphists would be able to fulfil the exacting requirements of the India Board. They are not, as a rule, "the scions of noble sires" (in the ordinary acceptation of the terms), nor can they boast an *Alma Mater*, but there is abundant evidence to show that many of them are qualified and worthy to occupy the most responsible positions in a telegraphic establishment; and it is indeed a pity that they should be excluded from advancement in their profession, because their parents have been unable to afford them a classical education.

While pointing out the most forcible objection to the system on which appointments on the India telegraph staff have hitherto been made, we must not lose sight of the absolute necessity for special training to qualify intending candidates for the responsible duties of these offices. The superintendents and assistant-superintendents of telegraph lines in England have abundant opportunities for increasing their knowledge of the subtle agent which has been made so marvellously subservient to the purposes of mankind, and by-and-by this possession will prove the *sine qua non* to position in the telegraphic world. Electricity has been brought from the clouds to run on our messages, to direct the storm-tossed mariner to ports of safety, and for innumerable other uses in the arts and sciences; but of the nature of this mysterious fluid we are as profoundly ignorant as were our ancestors. We have ascertained a few of the circumstances under which it obeys our behests, but if we endeavour to trace its source, to analyse its substance, we are imperceptibly led into a series of hazy speculations, and after awhile feel disposed to abandon the pursuit, and derive a poor consolation for disappointment by including electrical in the category of the occult sciences. There is, therefore, abundant scope for the telegraphist to distinguish himself by observation and experiment. The phenomena constantly occurring around him has yet to be reduced to a science by patient research. The labours of Faraday, Wheatstone, and other investigators, are of a pioneering character; it yet remains for some humble experimentalist to demonstrate the laws of electricity, and none are more likely to be able to do so than those daily engaged in its applications. The scholar and the bookworm are poor competitors with practical men; and however discouraging the present prospects of honourable advancement may seem, the time is not far distant when it will be found that men who have profited by their occupation in telegraphy at home, are far better qualified to superintend the working of the telegraph in our Indian possessions than students from the various seminaries of learning.

THE ELECTRIC TELEGRAPH IN EUROPE AND AMERICA.

The historical investigations of the late Dr. Hamel into the origin of electro-telegraphy are works of great value and reliability. The doctor spared neither trouble nor expense in his efforts to establish the claims of his ingenious and illustrious countryman, the Baron Schilling, as the first contriver of an electric telegraph. At our request several valuable papers were contributed by him to telegraphic literature some two or three years ago, and at the time of his death he was engaged in collecting some additional important facts illustrative of the early progress of telegraphy in Europe, for which purpose his Imperial Majesty the Emperor of Russia had ordered copies of valuable documents, preserved at the Imperial Library, to be furnished him.

During a lengthened conversation we had with Dr. Hamel on the closing day of the International Exhibition of 1862, the contents of those documents were confidentially imparted to us. The facts disclosed in those papers had materially modified the views of the doctor with regard to the claim urged on behalf of Mr. Fothergill Cooke and Mr. Charles Wheatstone, as the gentlemen to whom the world is indebted for the realization of an electric telegraph:—

After all that had been accomplished before the month of September, 1837, in Europe by Baron Schilling, by Weber and Gauss, by Steinheil, and by Cooke and Wheatstone, it is offensive to observe that in America the painter Morse, who made on the 4th of September, 1837, a poor experiment which he considered "successful," is held out as having made an electro-magnetic telegraph before anybody in Europe.

Samuel Finley Breese Morse—born 1791, the eldest of three sons of the late Rev. Jedediah Morse, known for his geographical publications—having a taste for painting, and wishing to study this art, had for that purpose, from 1811 to 1815, been in England (at London and Bristol). At the close of 1829 he came again to Europe, and went by London and Paris to Rome and Naples, thence back to Paris, where he remained about a year to copy paintings in the Louvre. In the autumn of 1832 he returned from Havre to America.

On board the packet ship, the Sully, there was, among other passengers, Dr. Charles T. Jackson, of Boston, who had attended in Paris, besides other lectures, those of Pouillet, at the Sorbonne. I call to mind here that Pouillet the year before, in 1831, had had made his large electro-magnet, which supported the weight of more than one thousand kilogrammes.

During the voyage, which lasted from the 8th of October to the 15th of November, Dr. Jackson repeatedly directed the conversation to the subject of electricity and electro-magnetism, which gave occasion to speak about the possibility of electro-magnetic signalising or telegraphing. Dr. Jackson had with him on board a small electro-magnet, which he had bought in Paris, at Pixii fils, and also a small galvanic battery. He pointed out some means as likely to serve for the purpose mentioned by sketches, some of which I have seen in Dr. Jackson's pocket-book.

Arrived at New York, Morse endeavoured to gain his livelihood, as had been the case formerly, by painting portraits.

He being now always called professor, most persons believe that he is a professor of natural philosophy, or some other branch of natural science, but this is not the case. In 1835 he got the title of "Professor of the Literature of the Arts of Design." It was supposed that he might, in the so-called University of the city of New York, where he was then lodged, lecture on that subject, but he has never, as I know from himself, given one single lecture thereon to pupils.

As his occupation in painting portraits ever since his return from Europe in 1832 hardly produced him the means of supporting himself, he, towards the end of 1835, after Baron Schilling's exhibition of his telegraph at Bonn, undertook to try to arrange something for signalising by means of electro-magnetic action, of the possibility of which Dr. Jackson had informed him, but his trials remained without success, because he did not know what was wanted to make a powerful magnet. Two years later, in 1837, when news of the above-described doings in Europe reached America (his brother Sidney was editor of a newspaper), he, with the aid of a scientific gentleman, who knew what Professor Henry, then at Princeton, had done with regard to electro-magnets, produced something which, however, was not at all fit for practical use.

Professor Henry and Professor Bache, from America, had been in 1837 in London, and had visited Professor Wheatstone in King's College on the 11th of April, which was six weeks after Mr. Cooke had been with him. During the summer Professor Wheatstone had signified to some Americans his wish to make an application for a patent at the Patent-office in Washington.

Morse's idea, then, was not to produce on paper letters or signs representing them, but to have only ten signs for the nine digits and the zero. With these he proposed to express numbers on strips of paper. In an alphabetical vocabulary the words were all numbered. He had an eleventh sign which served to indicate that the next following signs were really to represent numbers, not words. For each of the signs mentioned he had a metal type with a certain number of Λ shaped projections. These types he introduced, one after the other, into a port-rule, by which they were moved forward. The teeth of the types were to lift a lever, by means of which the electric current was allowed to flow through the coils of an electro-magnet, causing it to attract an armature fixed to a moveable vertical lever having at its lower end a pencil, which marked on a strip of paper, passing slowly over a roller, zig-zags somewhat like the teeth of a saw.

To find out afterwards what the groups of zig-zags meant, one had to convert the digits they represented into numbers, and then look into the vocabulary for that number to learn what word was meant by it.

It was Dr. Leonard D. Gale, professor of chemistry, living in the same building as Morse, who had instructed him how to make the coils for an electro-magnet; he also procured him the necessary wire, and lent him a proper galvanic battery. Morse made him afterwards his partner, and he from 1846 held until lately a situation in the Patent-office.

When, at the end of August, 1837, amongst other news from Europe, there came in a German newspaper—the *Neue Würzburger Zeitung*—an account of the 30th of June, about Steinheil's doings at Munich, which was translated into a New York paper on the 1st of September, there was, through Morse's influence, on the following day an article printed, saying that the editors of newspapers in America, who copy such articles from European papers, do not seem to be aware that the electric telegraph—which now, as the wonder of the age, seems to have excited in Europe the attention of the scientific public—was an American discovery, and that Professor Morse had conceived it five years ago (1832) on his return from France to America. It was added "that Morse had on board the ship made no secret of the general idea, but communicated it freely to his fellow passengers of all nations, who were on the ship."

Was not this to make the Americans suppose that Baron Schilling, Weber, Gauss, Steinheil, Cooke, and Wheatstone might have learnt from Samuel Morse the art of telegraphing by electro-magnetism? As it was also mentioned that Morse had his telegraph then near his lodgings, there came on the same day several curious persons to see "the wonder of the age." One of them was Dr. Daubeny, from Oxford, in England. Another was a young gentleman, Alfred Vail, who afterwards became very useful to Morse, for he, with his brother George, made at the Speedwell Iron Works, near Morristown, in New Jersey, belonging to them, a much better instrument than that invented by Morse. Alfred Vail became, like Dr. Gale, Morse's partner.

On the day mentioned, the 2nd of September, Morse's machine would not mark anything correctly. Great efforts were employed to make it do better, and two days later, on the 4th of September, Morse at last succeeded in getting by it the numbers representing five words and the date marked. For this were wanted not less than sixty-two zig-zags, and fifteen straight lines on the slip of paper, the figure drawn on it looking somewhat like a saw-blade, with teeth here and there broken out. They represented the following numbers: 215, 36, 2, 58, 112, 04, 01837. Searching in the vocabulary for the meaning of these numbers, it was found that they were to express: "Successful experiment with telegraph, September 4, 1837."

The triumph was immediately sent for publication to the editor of the last-mentioned newspaper, and also to Professor Silliman at Newhaven, the editor of the *American Journal of Science and Arts*, and with it was sent a representation of the wonderful production.

It is to be seen on p. 168 of the 23rd volume of the said Silliman's journal; also in the London *Mechanics' Magazine* of the 10th of February, 1838.

Morse wrote at that time: "I assert to be the first proposer and inventor of electro-magnetic telegraphy—namely, on the 19th of October, 1832, on board the packet Sully, on my voyage from France to the United States. . . . All telegraphs in Europe are, without one exception, invented later than mine."

So spoke the painter Morse in America after having, with the machine which Dr. Gale had assisted him to construct on the 4th of September, 1837, obtained the described poor result. He claimed priority to everything done in Europe in the department of telegraphy. His, for practical purposes, worthless result he had obtained four weeks after the death of our Baron Schilling, who, as we know now, had, twenty-seven years before that time (1810), at Dr. Soemmerring's, at Munich, got acquainted with the first galvanic telegraph in the world, who, above a dozen years previous, had made at St. Petersburg the first electro-magnetic telegraph, which he had himself two years before exhibited to the meeting of the naturalists at Bonn, where it had so pleased that it was taken immediately to Heidelberg, and half a year afterwards from thence to England. Here a telegraph on the principle first used by Baron Schilling had, forty-one days before the 4th of September, been at work over a mile and a quarter of line in the open air, and through many miles of wire suspended in a building at the terminus of the railroad near Euston-square, in London; and Schilling had, not long before his decease, at a rope manufactory at St. Petersburg, ordered a submarine cable to be made to unite Cronstadt with the capital through the Gulf of Finland for telegraphic correspondence.

It is to be regretted that Morse, when in 1838 he, with and at the expense of a commercially-interested member of Congress, Francis O. J. Smith, came to Europe, wishing to get his apparatus patented in England and in France, was in Paris told that Baron Schilling had invented his electro-magnetic telegraph some time after his return from the frontiers of China in December, 1832, and in 1833. This erroneous statement became for Morse a welcome encouragement to confirm to himself the ill-founded priority of October, 1832, and unfortunately, in most of the works printed since that time, Baron Schilling is stated to have invented his telegraph in 1833.

We have seen what sort of a telegraph Morse, with the aid of Dr. Gale, had (in 1837) invented. It was a thing quite useless for practical purposes. Alfred Vail, with his brother, very soon after made for Morse, as I have already mentioned, a better one, and in the course of a good many years that practically very useful instrument was brought about which at present goes by the name of Morse's.

The first telegraph line in England was constructed by Mr. Cooke from London (Paddington) along the Great Western Railway to West Drayton in 1838-39. In 1840 he established the telegraph along the Blackwall Railway, and in 1841 a short line from the Queen-street station at Glasgow, through the tunnel to the engine-house at Cowlairs, on the railway to Edinburgh. In 1842-3 the line from West Drayton was continued to Slough. In 1843 two short lines in Ireland and in England were made; but in 1844 one of considerable length, all the way from London to Portsmouth, was done for Government. Some tunnels were also furnished with telegraphs.

SIGNAL LAMPS.—A new adaptation of petroleum has been made by Mr. J. Turner Hall, gas engineer to the London and North-Western Railway Company, Edge-hill Station. The great illuminating power of petroleum is generally acknowledged, but objections have been urged to its intended use owing to the accidents which have resulted from it from time to time. These casualties have, however, been attributed to the employment of the oil in its crude or partially and imperfectly prepared state, and to the lamps in which it was burned not being adapted for the purpose. Mr. Hall directed his attention to mineral oils for signal purposes and the lighting of railway stations, and after a series of experiments has succeeded in constructing a signal lamp and lantern in which petroleum may be used with perfect safety, and a brilliant and uniform light be obtained. The light is not affected by gusts of wind. It is already in successful operation in several of the stations on the London and North-Western Railway. In addition to its employment for railway signals it may also be used for lighting coal and other mines, lighthouses, and similar places. It is said that whilst the new petroleum lamp gives a large excess of illuminating power, the actual cost as compared with other oils is less by upwards of 50 per cent.

FIRING GUNPOWDER BY ELECTRICITY.

In our impression of this week will be found an account of some very important experiments with torpedoes at Chatham, and the following extract from a report presented to the Secretary of State for War, on the result of elaborate investigations and experiments made at Woolwich and Chatham by a Committee on the application of electricity from different sources to the explosion of gunpowder, will be found interesting. The report was drawn by Professor Wheatstone and Mr. Abel, chemist to the War Department:—

"1st. The explosion of a single charge of powder by means of the phosphide of copper fuze and a magneto-electric apparatus (even of the smallest size generally manufactured) is absolutely certain.

"2nd. The phosphide of copper fuze is as safe and permanent as any arrangement employed in the service for the ignition of gunpowder by the aid of friction or percussion.

"3rd. With the employment of a magneto-electric apparatus similar to that used in the Chatham experiments, and termed by Mr. Wheatstone the 'magnetic exploder,' the ignition at one time of fuzes, varying in number from two to twenty-five, is certain, and provided these fuzes are arranged in the branches of a divided circuit in the manner described. To attain this result, it is only necessary to employ a single wire, insulated by a coating of gutta-percha or india-rubber, and simple metallic connections of the apparatus and the charge with the earth.

"4th. The explosion of from twelve to twenty-five charges may be effected in the above manner at a distance of at least six hundred yards from the apparatus, with a rapidity which in its results will, in all probability, have the practical effect of a simultaneous discharge. This statement, however, only refers to charges on land.

"5th. The number of submarine charges which can be exploded with certainty at one time, by means of the magnetic exploder, is more limited; but if such charges are entirely or partially embedded in sand, mud, or other dense materials, from two to ten may be fired with certainty. If the charges are suspended in, or are immediately in contact with water, only four can be exploded at one time with certainty. By the employment of separate wires leading from the instrument to each charge, there is little doubt, however, that the results obtained with the magnetic exploder in submarine operations would be quite equal to those definitely established for the ignition of charges on land.

"6th. The only important precautions to which it is necessary to attend rigidly in order to ensure uniform success in the application of the magnet, are the proper insulation throughout of the main wire and branch wires leading from the instrument to the charges, and the thorough protection of all connections of wires from the access of moisture.

"7th. The system of firing charges by magneto-electricity thus possesses important advantages over the application of the voltaic battery to this purpose, the principal of which are, the small dimensions, weight, and cost of the magnetic exploder; that used in the experiments alluded to in this report weighed only 32 lbs. 11 ozs., and all the arrangements in connection with the instruments are so simple that any injury which they may sustain can be repaired by ordinary workmen."

The employment of electricity for the explosion of gunpowder is by no means new. Franklin and Priestley effected the explosion of gunpowder, &c., the former in 1751 and the latter in 1767; but, however, it was not till after the discovery of the voltaic pile that earnest and practical endeavours were made to apply electricity to mining and military purposes. Electricity is now employed for ascertaining the velocity of projectiles with the most satisfactory results, although when we proposed the application of electricity for such a purpose to the authorities at the War-office some twenty years ago, we were little better than laughed at.

PRACTICAL APPLICATION OF THE SPECTRUM ANALYSIS.—A beautiful practical application of the principles of the spectrum analysis has recently been made in the casting of steel. In a newly-adopted process of melting the metal, it is important to know the exact moment at which to shut down the cover of the furnace; time must be allowed for the escape of the gaseous products, which are injurious to the steel, but if that time be prolonged, an injurious effect of another kind is produced. To meet this contingency, it has been proposed to test the gases as they fly off, by means of the spectroscope, and as soon as the particular colour is observed, peculiar to the gas, which begins to escape at the moment the molten metal is in proper condition, the manufacturer will then have an infallible sign of the proper moment for closing the furnace.

THE INTERNATIONAL EXHIBITION, 1862.

(Concluded.)

Mouilleron & Vinay, Paris, M. (France, 1,438), exhibit their "*hydrostatimètre*," an instrument by which the level of water in a cistern is shown by an index placed in any required position at a distance from the cistern. This is effected by the agency of a float, which makes and breaks an electric circuit, sending positive currents at certain intervals as it rises, and negative currents at the same intervals while falling. The positive currents move the index of a step-by-step dial instrument in one direction, and the negative currents move the index in the opposite direction. The receiving apparatus is very simple; two polarized electro-magnets on Messrs. Siemens' system are so arranged that the armature of one works a ratchet-wheel in one direction, while the armature of the other works a similar ratchet-wheel on the same axis in an opposite direction; the two coils are both in one circuit, but the positive current alone moves the one armature, and the negative the other; the opposite currents simply press the motionless armatures harder against their stops—a position in which their pallets are clear of the ratchet-wheels. The ratchet is prevented from turning when the armature pallets are clear of them by a little spring friction pallet.

The transmitting apparatus is more complicated, and can hardly be described without drawings. As long as a float continues to rise it sends, at definite intervals of, say three inches, momentary positive currents; when nearly stationary it may oscillate up and down sometimes two inches lower and sometimes two inches higher than the level at which the last current was sent, without sending any current; it must fall or rise fully three inches after sending a given current before it sends any fresh current. Moreover, when it has *risen* three inches it will always send currents of opposite name to those sent after a *fall* of three inches. The problem is by no means an easy one, and appears to have been successfully solved.

Messrs. Mouilleron & Vinay received a medal for this apparatus.

A. Achard, Paris, M. (France, 1,023), exhibits in Class VIII. an electric self-acting feed, for supplying water to the boilers of stationary engines. In this invention, as in the railway brake described below, M. Achard uses the voltaic current simply to stop or hold an armature. When the armature is loose one of two pauls constantly worked from the engine turns a segmental ratchet, opening the feed-cock; but when the armature is held by the passing of a current through an electro-magnet, one paul is thrown out of gear, and the second paul into gear, working a second segmental ratchet which shuts the cock. When the cock is either fully open or fully shut, the paul in gear works in a blank space. The connections are made or broken by a float mechanically connected with a commutator outside the boiler; if the circuit fail at any point, or if the battery become too weak, the worst that can happen is that the armature would be released permanently, so that the boiler would get filled with water. Moreover, M. Achard uses a second armature, worked by the same current to ring a bell when the current is interrupted, in which case it rises and falls with an oscillating lever driven by the engine, and at each fall causes one beat of the bell. When the current is re-established this armature is held up out of the way of the oscillating lever, and the bell stops ringing. This current is interrupted by the float when the boiler is too full or too empty; the bell in either case acts as an alarum, and it also draws attention to any accident, in consequence of which the connecting wires may have been broken, or the battery become too weak. This electrical apparatus seems as certain in its action as any mechanical construction; indeed, if a failure can possibly occur in any part without being at once discovered, it would be in the float, which might possibly stick instead of following the surface of the water. This apparatus has been successfully applied in France.

M. Achard also exhibits an *electric brake* for use on railway trains. The electric current is not directly employed to produce the friction or retarding force, but the required power is obtained from the momentum of the train itself, by letting a cam on one of the axles of each carriage work a paul, which turns a second shaft round by means of a ratchet-wheel upon it. This second shaft, by winding up a chain, pulls the friction blocks against the rim of the carriage wheels until, by the stoppage of the axle, further action is prevented. Electricity only comes into play in so far as it is used—first, to determine the moment at which the paul shall begin to act; and secondly, to release the chain, and so take off the brake at the moment required.

The first object is very simply attained. The paul is on one end of a lever, rocking freely on the ratchet shaft. A prolongation of the other end of this lever is pressed by a spring against the cam on the axle. When the axle revolves this spring keeps the lever against the eccentric surface of the cam, and so rocks the lever and works the ratchet by the paul; a soft-iron armature is attached to the other end of the lever, which, as the lever rocks, slides back and forwards over the poles of an electro-magnet. The cam always pushes this slide back to its farthest limit in spite of any attraction of the magnet, even when a current is circulating round the coils; but when the cam recedes, the spring is not strong enough while the current circulates to pull the slide forward again, and it consequently remains motionless at the furthest point, so that the paul is no longer moved. A current passing round the electro-magnet thus prevents the brake from being applied, or stops its further application, but the moment the current is interrupted, the spring works one end of the lever, pulling the slide forwards, the paul takes up successive teeth of the ratchet, and the brake is applied with more and more force until the wheel is stopped.

The brake is released by means of a second system of electro-magnets. The ratchet-wheel is not rigidly fixed to the shaft on which the brake chain is wound, but connected with it by what may be called an electro-magnetic friction clutch; indeed, all M. Achard's contrivances are very properly referred by him to this leading idea, they all depend on the action of some sort of clutch worked by electricity. In this case the flat poles of a number of electro-magnets fixed to and round the shaft come against the flat faces of a disc of iron attached to the ratchet-wheel. When a current is established round these electro-magnets the disc adheres very tightly to them, and this is the case when the ratchet is used to put on the brake; but the moment the current is interrupted in this second circuit, there is no force to hold up the brake blocks, which fall back from the wheels by their own weight, turning the shaft round and unwinding the chain. Thus there are two circuits, which may be called the paul circuit and the clutch circuit. Normally the current is established through both; if the first be interrupted the brake is put on either slightly; if the interruption lasts, but a little while; or so strongly as to stop the wheel if the interruption continues. A short interruption in the second circuit again takes off the brake. The same circuits may be employed for all the carriages, or the train might be divided into short sections, each with a separate pair of circuits. The wires of the paul circuit might be so placed, that passengers in cases of great danger might cut them, and so apply the brakes.

M. Achard very properly applies the electro-magnetic force only to arrest the various armatures, instead of using it to do work. This invention has been tested in France, and favourably reported on by the Government engineer, and probably is open to as few objections as could be urged against any electric system used for the same purpose. Any accidental interruption in the paul circuit would be at once apparent, for the brakes would all be put on; but, on the other hand, an accident might occur to the second circuit without any obvious effect until the brakes were required. Finally, the writer fears that the trouble of making the connections required when the train is made up or subdivided, with the delays which would ensue in consequence of any mistake or accidental failure in the circuit, will prevent the adoption of any electrical arrangement in connection with any part of railway mechanism of such vital importance as the brake.

H. Garside, Manchester, M. (United Kingdom, 1,602), exhibits in Class VII. an *electric engraving machine*, used for engraving the cylinders of copper or brass employed in printing woven fabrics and paper-hangings. The voltaic current is used to determine, by means of electro-magnets, the slight simultaneous advance or withdrawal of any number of engraving diamond points from the varnished surface of the copper rollers to be engraved, according to the position of a corresponding metal contact point on the non-conducting surface of a prepared pattern. The pattern and cylinder to be engraved are moved mechanically in concert, and the proportion of their relative movements can be varied by mechanical adjustments. The engraving points have a slight vibrating motion given to them, which scratches off the varnish whenever brought in contact with it, and produces a series of fine zigzag lines which facilitate the retention of the pasty colouring matter used. The prepared pattern determines the moments at which this contact occurs, and the concert between the movements of the pattern and

the roller produces a similar agreement between the pattern and the figures engraved, which may clearly be made larger or smaller than the pattern in any desired proportion and in any required number. The copper, where exposed, is afterwards etched by an acid bath. This appears to be a very happy and legitimate use of electricity; the invention is of French origin.

Chevalier G. Bonelli, Turin, M. (Italy, 1,020), exhibits an *electric loom* in Class VII. This is an extremely ingenious contrivance, in which the usual Jacquard cards are replaced by an electrical arrangement worked by a pattern prepared on tinfoil with an insulating varnish.

A simple metal plate, perforated with holes, each of which is provided with a kind of piston, successively plays the part of each successive paper card in the usual arrangement. The pistons fill up every hole that is not required, but are withdrawn by electro-magnets from those holes, which require at each beat of the loom to be left open. This is effected as follows:—

A sort of metal comb, each tooth of which is the terminal of a separate insulated conducting wire, rests on the prepared pattern; whenever a tooth touches the tinfoil a circuit is completed through its conducting wire; but where a tooth rests on the varnish the circuit is broken. Each conducting wire includes in its circuit an electro-magnet. The pistons already spoken of are each composed of a small soft-iron shank and brass button-shaped head, and are all held horizontally in a frame, one opposite each electro-magnet. In one position of this frame the heads of these pistons project through the openings of the metal card or perforated plate; the diameter of each hole is a little larger than the head of the corresponding piston, each piston being exactly in the centre of its corresponding hole. In this same position all the soft-iron shanks touch the poles of the corresponding magnets, and the metal comb rests on the prepared pattern.

A certain number of the electro-magnets, corresponding to the uncovered portions of the tinfoil, are therefore active or attract the shanks, but the others exert no attraction. The frame with the pistons is now pulled forward away from the magnets; those pistons which are opposite the active magnets are held back, sliding in their frame, so that their button-heads pass behind the perforated plate, but the other pistons come forward with the frame, leaving the magnets. The perforated plate then drops a little way, and by this simple contrivance all those piston-heads which were in front of the plate are retained there, whatever pressure comes against them, for they are now excentric from the holes. The plate in this condition presents a perfect analogy with the common prepared card. A certain number of holes corresponding to the metallic parts of the pattern are vacant; the rest of the holes are blocked up, and present an unbroken surface, by which the proper hooks of the Jacquard loom are acted on during one stroke. The perforated plate is then brought back to the position first described, the prepared pattern is moved on a little step, and the same process repeated; thus, to use Mr. Le Neve Foster's words, "Each shift of the pattern, combined with the backward and forward movement of the frame carrying the pistons, produces a different series of holes in the plate, which thus becomes what may be called an universal Jacquard card, changing its face each contact in accordance with the requirements of the pattern."

When shuttles with several different colours are to be used, the pattern is subdivided into insulated portions, corresponding to the separate colours, by removing a very thin outline of foil round each; all the parts corresponding to one colour are afterwards connected. As each shuttle is thrown the battery is brought in contact with the appropriate series of insulated patches of tinfoil, producing a succession of different cards, and the pattern is not shifted forward until all the colours are exhausted. After the completion of each fresh combination on the perforated plate the battery circuit is broken by a proper contact-breaker, and the injurious spark is thus avoided, which would otherwise occur when the comb is lifted from the pattern prior to a shift.

The writer is unable to judge of the merits of the invention as applied to weaving, but the electrical arrangements are worthy of all praise. The smallest possible amount of work is thrown on the electric current, an essential condition for success with our present batteries. It is said that two cells of a Bunsen's battery will work M. Bonelli's loom.

FLEEMING JENKIN, REPORTER.

[The above valuable contribution to telegraphic literature will receive our further consideration in a future number.—ED. T. J.]

RAILWAY SIGNALS.

WE quote the following interesting communication which appeared in the *Times* of the 13th instant. Several articles have been published in our columns upon the important subject of "Railway Signals," in which the application of electricity has been strongly advocated. Our belief is that it is to electricity that we must look forward for the best and safest means of ensuring safety in railway travelling:—

To the Editor of the TIMES.

Sir,—Another of those fearful sacrifices of human life that are most improperly placed in the category of railway accidents has occurred at Egham. Distressing as is the lot of those who have to mourn the loss of friends and relatives, theirs is a comparatively merciful one when we think of those who have to suffer and those who have to witness the horrible torture of smashed limbs and other bodily injuries, which, although not sufficient to destroy life, leave the victim a miserable burden to himself and a life-long object of pity to those about him.

Without much hope of exciting the sympathies of those who in my mind are almost criminally responsible, I ask you to allow me to renew my protest against "the system" which has been the direct—the only cause of this terrible calamity, as it has been of many that have preceded it.

The company are anxious to make known the perfection of their arrangements. They say that neither the signals nor the signalmen are in fault; but, notwithstanding the perfection of their arrangements, the fact is before us—six or seven lives have been lost, and numbers of others have been mutilated and otherwise injured—injuries that in many cases will remain with them to the end of their days.

Accidents will occur, and to such as arise from unavoidable causes we must submit and take our chance. But events such as this at Egham—accidents as they are called—which take place within the limits of signals, need not, and never ought to occur.

It is most fortunate that the Prince of Wales was called to Windsor, instead of returning to town by special train, for if, as was currently reported, the unfortunate train had been stopped at Egham to allow the Prince to pass, he would have been most unjustly charged with being the proximate cause of the accident.

As I have before stated, I do not believe in perfection of arrangement as a means of securing safety, and, as far as possible, I would avoid special arrangements. I know the impossibility of timing the trains, so as to follow each other at certain distances, subject as that order is to disturbance along the road. Trains cannot be made to move like planets in their orbits, and it is this futile attempt at perfection of arrangement, taking no account of human frailty—this assuming that the regulations which have been issued will in all cases be rigidly observed, and that all will go on like clockwork—that has been the fruitful cause of many disasters in the past, and which will be found to have been the cause of the one at Egham.

In the semaphore signal rightly constructed and rightly used we have as complete a safeguard against collision, within the limits of the signals, as human ingenuity can devise. By a right construction I mean that they should be weighted, so that when untouched the arm will rise to a position at right angles with the signal-post. In this position it is known as a "stop signal." By a right use of the signal I mean that its permanent or normal position shall be to stop all coming trains; that it shall only be moved from this position in reply to the whistle of the engine-driver, and by a properly-appointed person in such a position in the station as to be able to command a view of the whole; and that, having cast his eye over the station, and finding it free from obstruction, he should then give authority to the engine-driver to pass on by depressing the signal arm. This I denominate the affirmative or positive signal.

Let us suppose that this system had been in operation over the South-Western Railway, not on the day in question alone, but as a permanent system of working the signals. The driver, on approaching Egham, would not have required to be told that before he could enter the station he must whistle, and obtain authority to pass on; this he would have done, because it was his daily practice—the habit of his life. Now let us transfer the view to the station, in all the hurry and bustle of collecting tickets. The station-master has no apprehension of a following train, because the signal is a standing protection; he knows that so long as the signal lever is untouched it cannot alter its position, and that without such an alteration no driver dare approach. He is thus enabled to concentrate his whole attention to the duty of despatching the train, and this being done, the signalman, seeing the road and station clear, would give the signal for the train to come on, holding the signal down until the train had passed into the station, and then allowing it to resume its position of a stop signal. A signal used in this way is an absolute safeguard to the station, rendering it impossible that a collision can take place within the limits of the signals on each side. I will not occupy your space by discussing the objections that have been put forth. I will only say that the assertion that the driver would run past the signal is unsupported by any human probability; he has every motive to observe the rule, none to violate it. It need not be the cause of any delay, and in the great majority of stations it would be attended with no additional cost. Surely it is a system worth trying; the signals are there, the men are there;

all that the signals would require would be to reverse their action, and there is not even the poor excuse of novelty, for the system is in operation at all junctions, and I have seen it in operation over an important and crowded line of railway in Lancashire for upwards of two years without the slightest inconvenience, and with the most satisfactory results as regards safety.

I am, Sir, your obedient servant,

Timberhurst, near Bury, June 10. THOS. WRIGLEY.

THE METAL INDIUM AND RECENT DISCOVERIES ON SPECTRUM ANALYSIS.

By PROFESSOR ROSCOE, F.R.S.*

SINCE the spring of 1862, when the speaker delivered a course of three lectures in this Institution on the Spectrum Discoveries, much has been done to increase our knowledge of Spectrum Analysis, but the whole subject is still in its infancy, and the further we advance the more we find remains to be known.

No less than four new elementary bodies have already been discovered by means of Spectrum Analysis: Cæsium and Rubidium, by Bunsen; Thallium, by Mr. Crookes; and Indium, by Reisch and Richter, of Freiberg; whilst the foundations of Solar Chemistry, laid by Kirchhoff, have been rendered more secure by the observations of Cooke, in America; Donati, in Italy; and Miller and Huggins, in England.

Cæsium and rubidium were at first only found in one or two mineral waters; they have since been shown to be widely distributed in the vegetable as well as in the mineral kingdom; they have been obtained in considerable quantities from the beet-root salt, and found in the ashes of tea and coffee, thus proving that they occur commonly in soil; whilst, quite recently, M. Pisani has found that a mineral called Pollux, occurring in Elba, contains 34 per cent. of cæsium, this metal having been mistaken for potash in the analyses which had previously been made of this substance. Thallium and its compounds have been obtained in large quantities, and their properties fully investigated by Crookes and Lamy, whilst this metal has not only been found in iron pyrites, but also in large quantities by Schrötter, in the mica of Zinnwald, and in lepidolite, from Moravia. Thallium has been shown by Boettger to occur together with cæsium and rubidium in the mineral water of Nauheim, near Frankfort; Boettger has, moreover, shown that thallium is contained in the vegetable kingdom, he has found it in the yeast of the vinous fermentation; so that thallium exists in wine; also in treacle, tobacco, and chicory. If 4 lbs. of any of these substances are employed, a sufficient quantity of thallium can be obtained, as the double platinum-chloride, to enable its presence to be easily detected. Professor Bunsen has informed the speaker that he has found a mother liquor from the Hartz, which contains so much thallium that the iodide can be obtained by direct precipitation in quantity at the rate of 10s. per lb. The speaker exhibited the spectrum of the Nauheim salt, which contains the three new elements; the spectrum of each metal is well seen by placing the mixed platino-chlorides in the electric arc.

Drs. Reich and Richter, of Freiburg, in Saxony, have lately discovered a fourth new metal in the Freiberg zinc blende. This metal has been termed Indium, from the two splendid indigo-blue lines which characterize its spectrum. Through the kindness of Professor Richter, the speaker had been placed in possession of a few grains of this new metal, the spectrum of which was exhibited by the electric lamp. In its chemical relations it resembles zinc, with which it is associated in nature; the metal can be reduced before the blowpipe to a malleable bead, when it forms a soft, ductile bead, which imparts streaks to paper on rubbing, and possesses a colour lighter than that of lead, being about the same as that of tin. The metallic bead dissolves in hydro-chloric acid with the evolution of hydrogen. The oxide of indium is formed as a yellow fusible incrustation when the metal is heated before the blowpipe on charcoal. Indium differs from zinc in the insolubility of the hydrated oxide in excess of both ammonia and caustic potash. This new element may be separated from all the known metals by precipitating its sulphide in alkaline solution, and by throwing down the hydrated oxide first with ammonia and then with caustic potash; and lastly, by precipitating the iron with dilute solution of bicarbonate of sodium. The hydrated oxide of indium then remains in solution in the pure state. Indium may be readily detected when present in its pure compounds by the deep purple tint which these impart to flame. The characteristic lines are, however, best seen when a small bead of indium salt is placed between two poles, from which an electric spark passes; the lines In α and In β fall respectively upon divisions 107·5, and 140 of the photographic scale of the spectroscope, when $Na = 50$, and $Sr\ \delta = 100{\cdot}5$. Up to the present time indium has been only found in the very smallest quantity, and hence the atomic weight of the metal and the composition of its salts have not yet been determined; in fact, the speaker was left to infer that Professor Richter sent him nearly all the compound of the metal remaining from the investigation of its properties, for the purpose of illustrating this discourse. It has only as yet been detected in the zinc blende of Freiberg; but it will, doubtless, soon be discovered in larger quantities, and its compounds more closely studied.

As regards the spectre of the well-known metals, our knowledge has been much increased by the publication of the second series of "Kirchhoff's maps of the solar spectrum and the spectra of the chemical elements" (Macmillan and Co.) In these Kirchhoff has marked the position of the bright lines of no less than thirty metals, and indicated those which, as they coincide with a dark solar line, reveal the presence of the particular metal in the sun's atmosphere. Kirchhoff's maps now embrace the whole of the visible spectrum from the line A in the extreme red to the line G in the indigo; beyond these limits the intensity of the light passing through his three prisms became too slight to enable him to draw the lines. The observations then made of coincidences of metallic with solar lines in the red and indigo portions of the spectrum confirm the conclusions drawn by Kirchhoff from his earlier observations, with the exception of the presence of potassium. This metal is not seen in the solar atmosphere; the potassium red line is not coincident with the solar line A, as it was supposed to be, nor with any other dark solar line. No metal, in addition to those previously observed, was found to possess lines coincident with solar lines, and hence the number of bodies known to be present in the sun has not been increased.

The experiments of Mr. Huggins on the spectra of the metallic elements, made with an instrument of six prisms, although not yet published in full, promise to add greatly to our knowledge on this subject: one interesting observation may be cited, viz., that the spectrum of sodium has been found to contain three pairs of lines in addition to those corresponding to the dark double line D, and that these also coincide with dark solar lines, adding to the evidence previously possessed of the existence of sodium in the sun. The audience had been already made acquainted with Dr. Miller's important researches on the photographic spectra of the metals, and with the valuable observations made by himself and Mr. Huggins on the spectra of the fixed stars. Connected with this part of the subject may be mentioned Professor Stokes's interesting investigation on the long spectrum of the electric spark, in which he shows that the vapour of certain metals, such as iron and magnesium, when heated by the passage of an electric spark, emit rays of so high a degree of refrangibility, that they are situated at a distance from the lines H, ten times as great as that of the whole visible spectrum from A to H. These highly refrangible rays only become visible at the highest temperatures, and they are not seen in the solar spectrum, although the less refrangible iron and magnesium lines are present. Hence it has been suggested that the temperature of the sun must be lower than that of the electric spark in which these lines are developed. This conclusion appears legitimate only if we know that these rays of high refrangibility are not absorbed in passing through our atmosphere; and an investigation of great interest here presents itself for those who ascend into the higher regions of the atmosphere.

The observations of Dr. Robinson upon metallic spectra have led this astronomer to doubt the validity of some of the conclusions arrived at by Kirchhoff concerning the existence of a separate and non-coincident set of lines in the spectrum of each metal. It seems, however, that Dr. Robinson employed only one prism and a low magnifying power, so that we must conclude that the observations from which he deduces the coincidence of certain lines as proving their identity in several metals, cannot impugn the results obtained by help of a larger instrument of sufficient power to resolve these apparent coincidences.

The original statement made by Bunsen and Kirchhoff concerning the spectra of the metals still remains unopposed by a single well-established fact—the statement, namely, that when a metal is heated up to a certain point, the spectrum of its incandescent vapour contains a number of fine bright lines which do not change their position with increase of temperature, and are not coincident with the lines of any other known substance. There is, however, no doubt of the fact that in the spectra of certain metals or metallic compounds new lines are developed by increase of temperature; and also that certain metals, as calcium, barium, and strontium, yield spectra of two kinds; one of these, seen at the lower temperature, and consisting of broad bands, being resolved at a higher temperature into bright lines. These bright lines do not undergo any further change on elevation of temperature, and characterize the true metallic spectrum, whilst the band-spectrum is probably produced by the incandescent vapour of a metallic compound which is decomposed at a higher temperature.

Our knowledge of the spectra of the non-metallic elements is, as yet, in a very incomplete state. To the researches of Plücker, we are especially indebted for information on this subject; he has shown that each metalloid possesses a peculiar and characteristic spectrum; hydrogen, for instance, yielding only three bright lines, all of which are coincident with dark solar lines; and nitrogen exhibiting a complicated series of bands. Plücker has lately come to the conclusion that many non-metallic elementary bodies, and among them sulphur and nitrogen, exhibit two distinctly different spectra when the temperature is altered, in this respect resembling the metals of the alkaline earths. This difference Plücker ascribes to the existence of these elements in two allotropic conditions.

A singular relation with regard to what have been termed the carbon lines was observed by the speaker. It has been stated that all the various forms of carbon compounds, when in a state of incandescent gas, yield identical spectra. This proves not to be the case; the spectrum obtained from the flame of olefiant gas is different from that obtained by the electric discharge through a vacuum of the same gas; whilst the spark, passing

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* Read before the Royal Institution, Friday evening, May 6th, 1864.

through a cyanogen vacuum produces a spectrum identical with that of the olefiant gas-flame, and through the carbonic oxide vacuum a spectrum coincident with that of the spark through olefiant gas vacuum.

As an illustration of the application of abstract scientific principles to useful practical purposes, the speaker stated that he had lately applied spectrum analysis to the manufacture of steel by the Bessemer process. One of the great drawbacks to the successful practical working of Mr. Bessemer's beautiful process for converting cast-iron directly into steel, has been the difficulty of determining the exact point at which the blast of air passing through the molten metal is to be stopped. The conversion of five tons of cast-iron into cast-steel usually occupies from fifteen to twenty minutes, according to the varying conditions of weather, quality of the iron, strength of the blast, &c. If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converting vessel into the moulds, or it contains so much carbon as to crumble under the hammer. Up to the present time, the manufacturer has judged of the condition of the metal by the general appearance of the flame which issues from the mouth of the converting vessel. Long experience enables the workman thus to detect, with more or less exactitude, the point at which the blast must be cut off. It appeared to the speaker that an examination of the spectrum of this flame might render it possible to determine this point with scientific accuracy, and that thus an insight might be gained into the somewhat complicated chemical changes which occur in this conversion of cast-iron into steel. At the request of Messrs. John Brown & Co., of the Atlas Works, Sheffield, the speaker investigated the subject, and succeeded in obtaining very satisfactory and interesting results. The instrument employed was an ordinary Steinheil's spectroscope, furnished with photographic scale and lamp, and provided with a convenient arrangement for directing the tube carrying the slit towards any wished-for part of the flame, and for clamping the whole instrument in the required position. By help of such an arrangement the spectrum of the flame can be most readily observed, and the changes which periodically occur can be most accurately noted.

The light which is given off by the flame in this process is most intense; indeed, a more magnificent example of combustion in oxygen cannot be imagined—and a cursory examination of the flame spectrum in its various phases reveals complicated masses of dark absorption bands and bright lines showing that a variety of substances are present in the flame in the state of incandescent gas. By a simultaneous comparison of these lines in the flame-spectrum with the well-known spectra of certain elementary bodies, the speaker has succeeded in detecting the presence of the following substances in the Bessemer flame:—Sodium, potassium, lithium, iron, carbon, phosphorus, hydrogen, and nitrogen.

A further investigation with an instrument of higher dispersive and magnifying powers than that employed, will doubtless add to the above list; and an accurate and prolonged study of this spectrum will probably yield very important information respecting the nature of the reactions occurring within the vessel. Already the investigation is so far advanced that the point in the condition of the metal at which it has been found necessary to stop the blast can be ascertained with precision; and thus, by the application of the principles of spectrum analysis, that which previously depended on the quickness of vision of a skilled eye has become a matter of exact scientific observation.

Another interesting practical application of our knowledge concerning the properties of the kind of light which certain bodies emit when heated, is the employment of the light evolved by burning magnesium wire for photographic purposes. The spectrum of this light is exceedingly rich in violet and ultra-violet rays, due partly to the incandescent vapour of magnesium, and partly to the intensely-heated magnesia formed by the combustion. Professor Bunsen and the speaker in 1859 determined the chemically active power possessed by this light, and compared it with that of the sun; and they suggested the application of this light for the purpose of photography. They showed that a burning surface of magnesium wire, which, seen from a point at the sea's level, has an apparent magnitude equal to that of the sun, effects on that point the same chemical action as the sun would do if shining from a cloudless sky at a height of 9 deg. 53m. above the horizon. On comparing the *visible* brightness of these two sources of light, it was found that the brightness of the sun's disc, as measured by the eye, is 524·7 times as great as that of burning magnesium wire when the sun's zenith distance is 67 deg. 22m.; whilst at the same zenith distance the sun's *chemical* brightness is only 36·6 times as great. Hence the value of this light as a source of the chemically active rays for photographic purposes becomes at once apparent.

Professor Bunsen and the speaker state in the memoir above referred to, that "the steady and equable light evolved by magnesium wire, burning in the air, and the immense chemical action thus produced, render this source of light valuable as a simple means of obtaining a given amount of chemical illumination, and that the combustion of this metal constitutes so definite and simple a source of light for the purpose of photo-chemical measurement, that the wide distribution of magnesium becomes desirable. The application of this metal as a source of light may even become of technical importance. A burning magnesium wire of the thickness of 0·297 millimetre, evolves, according to the measurement we have made, as much light as 74 stearine candles of which five would go to the pound. If this light lasted one minute, 0·987 metre of wire, weighing 0·120 grammes, would be burnt. In order to produce a light equal to 74 candles burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grammes (2½ oz.) of magnesium would be required. The magnesium wire can be easily prepared by forcing out the metal from a heated steel press having a fine opening at bottom; this wire might be rolled up in coils on a spindle, which could be made to revolve by clockwork, and thus the end of the wire, guided by passing through a groove or between rollers, could be continually pushed forward into a gas or spirit lamp flame in which it would burn."

It afforded the speaker great pleasure to state that the foregoing suggestion had now been actually carried out. Mr. Edward Sonstadt has succeeded in preparing magnesium on the large scale, and great credit is due to this gentleman for the able manner in which he has brought the difficult subject of the metallurgy of magnesium to its present very satisfactory position.

Some fine specimens of crude and distilled magnesium weighing 3 lbs. were exhibited as manufactured by Mr. Sonstadt's process, by Messrs. Mellor & Co., of Manchester.

The wire is now to be had at the comparatively low rate of 3d. per foot;* and half-an-inch of the wire evolves, on burning, light enough to transfer a positive image to a dry collodion plate; whilst by the combustion of 10 grains a perfect photographic portrait may be taken, so that the speaker believed that for photographic purposes alone the magnesium light will prove most important. The photo-chemical power of the light was illustrated by taking a portrait during the discourse. In doing this the speaker was aided by Mr. Brothers, photographer, of Manchester, who was the first to use the light for portraiture.

ON THE PATENT LAWS.

(*Concluded.*)

Mr. W. BRIDGES ADAMS writes:—

A strong effort is now making, by a small but energetic body of persons, against the continuance of the patent laws, on the ground that they are injurious to the general interests of the community. Could they make out their case, it would be quite right that the laws should be abolished, for the interests of a small body of persons, such as inventors, must give way to the general interest. It has been long conceded that individual property in matter is a general advantage, much more so than possessing matter in common. It could not be tolerated that large estates should be the property of individual owners save by the conviction that this ownership produces on the whole a larger usufruct for the general benefit. Nor would the owners of these estates portion them out in farms of greater or less size save from the conviction that by individual skill and possession they reap a larger rent. Were it not so, the land would be all in common and unenclosed. Every man in the community seeks as far as he can to obtain a monopoly of all the things he desires, and so the landlord has a monopoly of his estate, and in the farmer of his farm, and in the miner of his mine, and in the mill-owner of his mill, and so on through all the various conditions of propertied life. But that which gives the highest value to matter is mental ideality. Without this we should be mere clods—of the earth, earthy. Our talk would be of beeves, and we should scratch the earth's surface skin deep, as most half savages do, to get a scanty crop of grain and roots. To make mental ideality fructify and constitute public utility, we must do by it as we do by matter, give it individual ownership and enclosures, not mock, but real. For though it is quite true that even as unenclosed land will produce a wild crop, so will unenclosed mentality, but the value will be in the same proportion that rye grass bears to wheat of the highest standard. Men of mark and cultivation, and consecutive mental industry, will not sow that others may reap the harvest. They will either keep their ideas concealed, or they will set their investigating faculties at work to ascertain why, if the ideas of the brain are to be made common property, matter also should not fall into the same category. It is quite clear that the inventor has no inherent right in his invention beyond keeping it a secret, and that he can only turn it to his own profitable account by the agency of the community, who are to use it directly or indirectly, for if there were no community his invention would be valueless. His advantage and that of the public must advance with equal steps, and it is for the public who grant the right to consider whether, upon the whole, it is not more for their interest to protect and help these inventors than to thwart and starve them. Inventors proper are not numerous; even the patentee list—and far be it from us to assert that all patentees are inventors—the patentee list falls far short of the booksellers' list of large and small poets and rhymesters inclusive. They rank with, and are a part of, the original-minded men who have the perception of truth and beauty and analogy in all things—thought, language, sound, form, colour, and structure. In virtue of their instinctive and not mere imitative properties, they are men of genius who direct their fellows into new tracts, and constitute the great distinction between the English nation and the Chinese. Poets, bookwriters, painters, sculptors, musicians, chemists, and constructors, all fall into the same category, and are all represented by matter, and the nation may, if it chooses, deprive them of the right of property in their own creations. The

* From Messrs. Johnson & Matthey, of Hatton Garden.

poet and bookwriter gather their royalties from the manufacturers of books or may print themselves exclusively. The painters and sculptors gather royalties from the multiplication of their works in casts and engravings. Musicians gather royalties on the sale of their measured notes represented in print, and there is no more justice or policy in shutting out the constructor and chemist from their royalties or their originalities, than there would be in throwing open the writings of Kingsley, Dickens, or Tennyson, to the voluntary contributions of Paternoster-row. We do not wish to use the *argumentum ad hominem*, but, nevertheless, we cannot accept the arguments of interested men against patent laws, which act as a curb on their desires to possess a capitalist monopoly. They profess a desire to see inventors rewarded without patents, but they do not tell us how this is to be done. Is it to be by Parliamentary grant? How then is the inventor to be defined if there is no record of his invention, no making it patent? Is he to enter into a squabbling and canvassing contest with loud-tongued, unscrupulous pirates, and canvas the members for their votes? This would be to make it a matter of politics, like a contested election, in which the retiring student would have no chance against the brazen and unscrupulous man of action. But, say the opponents of patents, there is an injustice in giving an exclusive privilege to a man to-day for that which another man might invent to-morrow, or next day, or a month after. Similarly so might it be said, that it is an injustice for a duke to possess an estate which might next day or week have become the property of an earl had he not been forestalled; or that it is an injustice for England to possess New Holland, which might otherwise have become a possession of France. We cannot see the injustice that a man who is up and doing should take possession of that which had before his time no owner, and is in fact a creation, or procreation of his own. There has been much talk about the absurdity of many patents, and how few of them are of any value, while they are obstructive to inventors, and that it is necessary to sift them by a preliminary examination? Do people really understand what this means—that a man's secret—his invention—shall be canvassed and discussed, and the patent given or withheld at the option of the examiners? Is it possible to remove from a sanguine man's mind the idea that some wrong motive has been at work, that nepotism has refused to him what will be granted to some friend of an examiner. Warn the man, if it be needful, but give him his patent if he persists, and after he has specified, put it on trial, in full court, and expunge it from the records for sufficient reason. The man will then have justice, and the patent lists will not be damaged. Assuming that patents are useful to the public, as tending to make men work earnestly and consecutively at new things, it becomes necessary to ask what should be a good and fitting subject for a patent, and what not. What is novelty? It is an old saying that "there is nothing new under the sun." As regards the public, everything is new that has not been in use for a generation; and the fact that a thing has been recorded without being used should not invalidate an inventor from turning it into use under the protection of a patent. If a thing has disappeared from public use for the space of thirty years, it would be a positive advantage to the public that an inventor should have a patent—a mental enclosure—to induce him to foster it and give it a new birth. Still the outcry is of "monopoly," the cuckoo cry of free trade, as though there were any opponents of monopoly so strenuous as the inventive men, as though the whole world would not be a monopoly save for these beaters down of the old ways. The true monopolist is the capitalist, and man in possession by virtue of his position. He may allege that he is open to competition, but this openness is only in the sense that the doors of the London tavern are open to all customers who have money in their purses. In competition the race is to the rich, and the poor competitor is hustled off the ground. Let an inventor without a patent bring to bear any improved article in large demand, he will infallibly be competed with, and displaced by, the larger capitalist, whose small profit on a large return will leave no profit at all to the man of small return, who, perchance, has expended all his means in perfecting the new article. But if he be protected by a patent, the inventor can hold his own till he himself become a capitalist too strong to be damaged, unless ruined by processes on the part of the capitalist, owing to the defective state of the law. It is the inventor who breaks down the would-be monopolies of capital; and other competing inventors also, in their turn, break down the monopoly of the first inventor. They do not debar the capitalist from his right to compete in his accustomed fashion, but only to compete in the inventors' brains and new uses. Many prominent persons there are whose opposition to patentees is grounded on a case of defeated piracy, or in a desire to prevent all others but themselves from rising to eminence. This patent record and protection is the only fulcrum by which the inventive non-capitalist can lift himself to a level with the capitalist manufacturer, and disturb the stagnation which would else prevail. The competition of manufacturers is for quantity, not for quality. The inventors generally cheapen as well as improve—they substitute machines for human drudges, with far better results in quality. To attempt to reward inventors by grants is the merest moonshine. The reward would never get to the true inventors, but would be intercepted by the jobber; for the student qualities that constitute an inventor are not the qualities that canvass the attention of Governments or Government authorities. Even were it not so, how is the money value of an invention to be estimated? Only by its pecuniary success, giving an exclusive right to the owner, for a longer or shorter period, to manufacture or use himself, or to licence others so to do. But there is another argument used by the manufacturers which has a groundwork of reason; they allege that they can compete, on favourable terms, with all the world in manufactures, but that a patent in England, when there are no patents on the Continent for the same thing, puts them at a disadvantage with the foreigner. For example, the rise in price, and probably in profit, on English iron, enables Belgian iron masters to compete in the market of the world, subject always to the condition that the English iron masters can underbid them if very troublesome. But if upon any article, rails, or others, there be a patent right in England and none in Belgium, they must remain at a disadvantage. What does this amount to? That they seek to monopolise the iron manufacture, and, therefore, they should establish themselves in Belgium, or they should take the Continental patents for the invention, and so guard themselves. Anyhow, we do not see why their interest should be studied in preference to that of the inventor if they do not choose to help themselves by helping him. "But the patent law," say they, in a sudden accession of care for the interests of the inventor, "is a mockery, a delusion, and a snare to the inventor; so let us abolish the law." We may paraphrase it thus:—"The law of freehold in land is a mockery, a delusion, and a snare for the landholder, for it exposes him to be ruined in Chancery; therefore, let us abolish the law of freehold." I think that it is far better in the interest of the public to amend the law, and I would do it after the following fashion:—1. I would define novelty to consist in the fact that the thing patented had not been in use in England for a term of thirty years previous to the application. 2. I would have an applicant warned by the proper authorities that his application was for an invalid thing, but give him time nevertheless to record and specify, on the ground that no examiners should be entrusted with a power to refuse an application for reasons which might be insufficient or possibly interested. But as soon as the specifications were lodged, it should be put on trial in open court, at the cost of the community, and erased from the records for good and sufficient reasons, removing a stumbling block, or expunging any part of it required. 3. That all new and original things in a patent for any specific invention should convey a right to their use in every manner, *i.e.*, a new thing specified in an improvement for one machine should be applicable to every variety of machine, and an inventor should not be obliged to take two several patents for a gun and shot, or for wheels and rails. 4. That the patent should be renewable as a matter of course if the inventor, from no fault of his own, but from difficulty of introducing it, had failed to realise a certain rate of profit to be determined on. 5. That all trials as to patent validity, constituting it a property or otherwise, should be before an especial patent court, whose favourable verdict should be essential to patentee litigants before going into a court of law to obtain damages. We do not think that the tendency of disinterested public opinion is against patents, but the contrary. The chief opponents are those who wish capital to be individual property and brains common stock. The patent is the trade mark of the inventor; and if that be taken from him, we trust that the trade marks of the manufacturers will be thrown open at the same time, for these trade marks, earned by long and hard work, are as much a monopoly in the market as the patent earned by the long and hard work of the inventor, for if one trade mark may compete with another, so also may one patent compete with another. We should like to know of what kind is the reward proposed by Mr. Hawes for inventors? On him has descended the mantle of his relative, the late Mr. Brunel, and it is upon the records of the Committee of the House of Commons that Mr. Brunel's idea was that all inventions were made by workmen, and that a good master would reward them well,—one pound sterling for an ordinary invention, and five pounds sterling for something extra good. Mr. Hawes's definition of the distinction between copyright and patent right is hardly logical. What does copyright mean but the exclusive right to manufacture a particular book, and what does the patent right mean but the exclusive right to manufacture something else—the book originating in one brain and the something else in another. Invention is essentially forethought—a grapple with the future. Contrivance is afterthought—a patch upon the present, but the contrivance coming into an existing market is always better paid than the invention, and the inventor is frequently sneered at as being before his time. But for all that, it is the inventor who changes the face of the universe for the better, and lessens the drudgery of humanity, and adds to its resources and pleasures, while the capitalist and contriver reap the profits. It will be an evil day for the world if ever the counsels of Achitophel shall prevail to the starvation of originators. Nor do we see the justice of compelling the inventor to licence his rivals who may be interested in damaging his plans by bad workmanship, and over whose dealings he can have no satisfactory control. Some years back there was a humourous illustration of this practice. An umbrella-maker advertised "the best silk umbrellas from 7s. 6d. upwards," and then added, with a vindictive animus against Sangster, from whom he had been compelled to take a licence, "N.B. A parcel of ugly alpacas on hand." Meanwhile the clear brain of the Lord Chancellor is getting in the thin end of the wedge, and his efforts will, doubtless, culminate in an Inventors' Court of Equity, for the legalisation of mental title deeds, at the cost of the Accumulated Patent Fund.

Mr. EDMUND HUNT writes:—

Referring to the discussion on the 20th inst., I think it is a pity that, in order to avoid confusion, separate occasions were not chosen for dealing with the two great sections of the subject:—The question whether legal protection of inventions should be retained or abolished? and the question

whether the existing patent laws could be improved, and how? As to the first, I would ask whether protection should be retained from principle or from expediency? I think the only sound arguments in its favour are those grounded on expediency; and if so, what may be expedient now may not be so ten years hence. Ten years ago I was enthusiastically in favour of patents; but unusually good opportunities for studying the subject, and for general observation thereon, have brought me gradually round to the firm conviction that the time is not far off when it will be better, both for the inventor and for the public, for patents to be abolished. But I must by no means be ranked with certain recent agitators against the patent laws, for I believe the very injudicious and faulty character of their arguments will have the practical effect rather of retarding than of hastening the abolition of patents. I do not, however, think that patents will be abolished at present, and it would therefore be a waste of time to enter very fully into this branch of the subject. And although I hold opinions against the future expediency of patents, I do not suppose I am, on that account, the less likely to have sound views as to the practical defects of the existing laws and their remedy. As to definitions, which, as was truly observed, are of great importance in a discussion of this kind, I would call that a non-patentable discovery in which we find out how two things have been combined, or have acted on each other; and that a patentable *invention* in which we combine or make to act together two things which, as far as we are aware, never before were so combined or made to act. In the strict sense of the terms, the human mind is utterly incapable of creating or originating even ideas. It receives its materials from without, and simply re-arranges them, and that not after any new plan, but in more or less close imitation of arrangements it has seen. A great many frivolous remarks are often made in discussions of this kind about patents for frivolous things. If the things referred to are really frivolous, how can the public possibly suffer from their being patented, seeing that no one is bound to buy or use a thing because it is patented, and that no one will buy or use a thing that is, in his opinion, frivolous? The patentee is the sole loser, namely, of his time and trouble, and of the cost of his patent; but it is useless to tell him it is frivolous—he knows better. Obviously the moment anything becomes useful and is wanted, it ceases to be frivolous. All plans for dealing with the merit or value of inventions, in anticipation of their use, are utterly impracticable. I also consider it impossible for a board of examiners to deal satisfactorily, in all cases, with the question of novelty. The American system has not worked satisfactorily. But it is certainly not right that when an inventor pays Government for documents ostensibly giving him a certain protection, his payment should be received as for a *bona fide* protection, when there exists in the Government office the means of knowing that, in many cases, it is worthless, from protection having been previously granted for the same thing. It is like obtaining money under false pretences. The remedy is, in my opinion, to employ a staff of examiners and searchers, who, as soon as possible after the receipt of every application for a patent, with a description of the invention, shall compare the same with existing patents and other records, and shall draw up a report, stating in what cases the invention appears to have been in any way anticipated or even approached. This report should be delivered to the applicant, and it should be left to himself whether to complete his patent or not; whilst, to prevent parties from imposing on the public by completing their patents, in the case of the inventions being old, and in face of the reports to that effect, such reports should be accessible to the public, and be printed along with the specifications. Surely a patentee is entitled to receive for his freely-paid fees a return such as the information contained in the report would be. In this plan I thus propose to adopt the good features of the American system, without the faulty feature of the arbitrary power of refusing a patent. But I believe that what would be found in practice to be the most advantageous alteration the present Patent Laws are capable of, would be to enact that the public use of an invention by the inventor or in imitation of him, for a period previous to his applying for his patent, should not invalidate such patent. In our own Indian Patent Laws twelve months are allowed, and in the American laws two years; and in America this provision has proved itself to be most valuable. At present in this country patents are taken out for a great number of things which prove impracticable or useless, but which, if the suggested alteration were made, would have been tried before it became necessary to apply for a patent. On the other hand, a great number of valuable improvements are continually being made without patents being thought of at the time, and afterwards when practical and recognised success suggests a patent, the inventor finds his publication of the improvement has debarred him from getting a valid one. With the alteration suggested, patents for such really valuable improvements would take the place in the lists of the class of useless ones previously referred to. The difficulty about compulsory licences arises from inherent defects inseparable from any patent system. Although, in consequence of existing prevalent ideas, but which have been fictitiously induced, a patent holds out a certain amount of encouragement to an inventor, it is still certain that it is often obstructive to improvement. Mr. Webster's challenge to cite cases of obstruction is ingenious; but numerous examples could easily be detailed; in fact, the larger portion of patent trials for infringement are due to it. The encouragement patents afford is measured out in doses not to be exceeded; and progress must take a stride only once every fourteen years! But it is said compulsory licences would obviate the obstructiveness of patents. They might, and have other advantages also, if a satisfactory system could be suggested. Has a practical system of compulsory licences ever been suggested? I think not. It would obviously not do for patentees to fix their licence rates without some check to prevent their being so high as to be prohibitory. I don't think the machinery of arbitration at all suitable; and any patentee determined to be obstructive, and having the means, could easily delay a settlement, or make it the starting point of interminable litigation. A plan which would make it against the patentee's interest to charge too high a rate would be most likely to work well; but no way of embodying that feature has occurred to me but one, which I fear is too complicated, and involves too much change in the general system of patents. I would reduce the fees payable on obtaining a patent to those barely sufficient to cover office expenses, but patentees should pay a tax on realised profits, to be fixed in amount in the following manner:—Every patentee should advertise his rate for granting licenses, and at regular periods give in returns of the number of machines sold, or equivalent particulars, and of licenses granted, and he should be taxed on such returns at rates corresponding to his own licence rates; so that the higher he fixed his rate the larger would be his tax. The preliminary fees might also be deemed to be a payment in advance to account of the periodical taxes. The following enactment is loudly called for, namely, that every patentee shall affix the number and date of his patent on every article made under it; and a penalty shall be exacted from any one using the designation "Patent" without having a patent. It is very remarkable that whilst in the case of designs such an enactment is in force, the laws of patents, of so much greater importance, are without it.

Mr. HARRY CHESTER writes:—

On Wednesday last I was, and on Wednesday next I shall be, unable to attend the meeting for discussing the Patent Laws. *Tempora mutantur nos et mutamur in illis.* I remember that, in 1864, the opinions, or (should I say?) the feelings, of those who attended our meetings were commonly in favour of patents, and even of our present Patent Laws. Now everyone gives up the latter as mischievous, and many are altogether opposed to the former. Regarding the patent system as one of the worst of lotteries, wherein the blanks bear a higher proportion than usual to the prizes, I think that the Society, while it promotes improvements of the system, so as to minimize its evils, should set itself to consider whether any substitute can be invented for the encouragement of inventors, or rather, I should say, for the honouring of great inventors. It seems to me that, while we have orders of merit for the reward or acknowledgment of great statesmen, diplomatists, lawyers, and military and naval heroes, we want an order for the acknowledgment of the merit of great heroes of invention in Arts, Manufactures, and Commerce. I do not pretend to indicate in detail the conditions under which such an "Order of Inventors" might be useful. I think the Society might appoint a committee to consider the subject; and I will only add here that it seems to me that it would be essential, first, that no award should be made in respect of any invention which had not been in use for a sufficient number of years to allow public opinion to be ripened in respect of it; and, secondly, that in special cases of great merit or need, a pecuniary recompense from public funds should accompany the grant of the order to the inventor, or to his heirs, or to both himself and his heirs.

THE RICHARD ROBERTS MEMORIAL.

The following circular has been lately issued:—

The Society of Arts, John-street, Adelphi, W.C.

It having been proposed by numerous persons conversant with the career of the late Mr. Richard Roberts that there should be some substantial and permanent record of the eminent services he has rendered to this country, and to the world at large, by his useful inventions, a public meeting was held at the house of the Society of Arts, on the 27th ult., when the following resolutions were unanimously passed:—

"That this meeting is of opinion that the eminent services which Mr. Richard Roberts has rendered to the manufacturing industry of this country, and to the world at large, by his useful inventions, demand some substantial and permanent record; and that the most appropriate tribute to his memory would be, in the first instance, to provide for the independence of his only daughter.

"That a fund be raised by public subscription, and that a committee be appointed to carry out the foregoing resolution.

"That this meeting, feeling that there are comparatively few beyond the circle of his scientific acquaintance who know how greatly Mr. Roberts has contributed to the wealth of the country, and to the material progress of the world, deem it expedient to issue an abstract of his memoirs, recounting the most conspicuous of his inventions."

Subscriptions will be received by Messrs. Coutts & Co., Strand, W.C.; Messrs. Hallett, Ommanney & Co., 14, Great George-street, Westminster, S.W.; Messrs. Heywood, Bros., of Manchester; and by the hon. secretaries.

P. LE NEVE FOSTER, J. WILLIAMS JONES, } Hon. Secs.

The following noblemen and gentlemen form the committee:—His Grace the Duke of Sutherland; the Earl of Caithness; the Right Hon. Lord Stanley, M.P.; Lord Alfred Churchill, M.P.; Admiral Sir Edward Belcher,

K.B.; W. Bridges Adams, Esq., C.E.; John Anderson, Esq., Royal Arsenal, Woolwich; J. G. Appold, Esq., F.R.S.; T. Bazley, Esq., M.P.; Byramjee Cama, Esq.; David Chadwick, Esq.; D. K. Clark, Esq., C.E.; Zerah Colburn, Esq., C.E.; W. Fairbairn, Esq., LL.D., F.R.S.; Lieut.-Colonel French; Oliver Heywood, Esq., Manchester; Peter Graham, Esq.; S. C. Homersham, Esq., C.E.; A. Hutton, Esq., Liverpool; S B. Lamb, Esq; W. H. LeFeuvre, Esq., C.E., F.G.S.; Henry Maudslay, Esq.; J. E. McConnell, Esq., C.E.; Lieut.-Colonel Munn, Newchurch, Lancashire; Jas. R. Napier, Esq., Glasgow; Dadabhai Navroji, Esq.; J. Pender, Esq., M.P.; John Penn, Esq.; Mark Philips, Esq.; Capt. Jasper Selwyn, R.N.; W. Smith, Esq., C.E; Samuel Thornton, Esq., J.P., Birmingham; John Trotman, Esq.; Thomas Webster, Esq., F.R.S.; Dr. James Whitehead, Manchester; Bennet Woodcroft, Esq., F.R.S.; James Wilson, Esq., Manchester.

Richard Roberts was born in Denbighshire, April 22nd, 1789, and died in London, March 11th, 1864, in his 75th year. In this long life his extraordinary inventive powers, and his skill as a practical engineer, contributed, to an incalculable extent, to the wealth not only of England, but of the whole civilized world. He first came to London in 1814, and was employed for a time in the factory of the Messrs. Maudslay, then the highest school of mechanical engineering in the kingdom. Three years later Mr. Roberts, then in business for himself in Manchester, made the first planing machine for iron, and which is still preserved in the Museum of Patents, South Kensington. His slotting machine and wheel cutting engine soon followed, and these, with his improvements in the slide lathe, may be regarded as among the most important of the aids which invention has given to construction. This series of inventions introduced a precision, celerity, and cheapness into the production of mechanism never before known, the results extending not only to the largest engines of ocean steamships, and to the endless machinery of the great factories of Lancashire, but down to the railway ticket press and the sewing machine. His talents and great practical abilities soon led to Mr. Roberts being invited to a partnership with the late Thomas Sharp, Esq., with whom Mr. Roberts established the Atlas Works, still ranking among the largest and most productive mechanical engineering factories in the kingdom. Here, in 1825, in consequence of the formidable strikes among the hand-mule spinners, he was led to the invention of perhaps the most ingenious, as it has been one of the most valuable, machines in the whole range of textile manufactures. This is the self-acting spinning mule, requiring only the attention of a child in the production of a thousand threads of an evenness and fineness unattainable by either the hand-mule or the throstle. Many millions of spindles are now worked upon Mr. Roberts's principle, not only in Lancashire, but in every civilized country. Shortly after the opening of the Liverpool and Manchester Railway, Mr. Roberts directed his attention to the improvement of the locomotive engine, and many of his original refinements in its structure and workmanship may still be traced in the railway engines of the present day; and of these, it may be added, nearly 1,500 have been constructed at the works where Mr. Roberts completed his first locomotive thirty years ago. One of his most valuable improvements introduced into the manufacture of these engines, and originally applied by him in 1825 in the construction of his spinning-mules, was the application of standard templates to the forms and dimensions of every part. This system permitted of the exact repetition of every portion of a machine to an endless extent, and it is that whereby the Enfield rifle is now made under a perfect division of labour; so that any one of a hundred thousand like parts fits exactly any one of an equal number of corresponding parts. Mr. Roberts received most tempting offers from the French and Russian governments to establish himself abroad, but declined, although he found time to design and put in operation Messrs. Koechlin's large engineering factory at Mulhouse.

During a long and active career he applied himself to the invention and introduction of improved turret-clocks, gas-meters, electro-magnets, silk-looms, and many other objects besides those already mentioned. In 1847, at the request of the contractor for the great tubes of the Conway Bridge, Mr. Roberts produced, almost *impromptu*, one of the most ingenious inventions known in metal working. This was the "Jacquard punching machine," an automatic tool of great power, whereby the rivet holes in a large plate are punched to any required pattern and pitch without need of templates or marking, and with a precision which enables any two of a thousand plates to be riveted together without subsequent correction of the rivet holes, as had always before been necessary. Without this invention the tubes of the Conway Bridge could not have been completed in time, while their strength was also increased and their cost of construction cheapened. The same punching machinery was employed in the construction of the Boyne Viaduct, the Victoria Bridge (the tubes of which are a mile and a quarter long) over the St. Lawrence, at Montreal, and for the great Jumna Bridge of the East Indian Railway.

In 1852, Mr. Roberts designed and made widely known his improved plans for ocean steamships of great size with the improved cross section of bow now adopted by our own and by the French naval authorities, and having besides double keels and twin screws, with independent engines, as applied with remarkable success in several steam-vessels of recent construction. These plans were for some time urged upon the Admiralty, and in 1855 they were submitted by Mr. Roberts, in person, to the Emperor of the French, who examined them critically, and in whose navy some of their peculiarities have been already adopted. In 1852, Mr. Roberts retired from the active pursuit of his profession, although, until within a few days of his death, he continued to practise as a consulting engineer. His habits and mode of life were marked with great simplicity, united with unceasing industry. A workman himself, he was ever the workman's true friend. Scientific and other institutions (especially in the locality of his early labours) found in him an earnest and liberal supporter. In his character, Mr. Roberts' integrity shone conspicuous. He abhorred a lie, and hated dissimulation with a heartiness which could only be best appreciated when he was opposed by the least departure on the part of others from what he believed to be the exact truth. His memory of what was essential to truth never faltered, and it has been said of him by Lord Campbell, Lord Brougham, and other eminent judges, that his answer would be always the same. At one time Mr. Roberts was in comfortable circumstances, but the loss he sustained by the forced sale of his property in Manchester, when its value had depreciated in consequence of the difficulties growing out of the stoppage of the American supply of cotton, left him with only his own exertions to depend upon. These he continued almost to the last hour of his long life, and only the day previous to his death, although in a state of extreme weakness, he dictated to his daughter, who had never left his side, a description of some improvements in the sewing-machine and in machines for cutting slate. Those who knew Mr. Roberts in private life spoke feelingly at the meeting of the noble example of filial devotion which his daughter's conduct had presented. Her graces and talents would have easily won for her a different position, but she preferred to sacrifice, not only her prospects, but even her health, as she has done, in order that her father's path to the grave might be smoothed by a daughter's affectionate care. Her case has excited an unusual degree of sympathy, and it is widely felt that the noblest memorial of the father's life and services will be a fitting provision for the daughter.

CORRESPONDENCE.

SUBMARINE TELEGRAPHY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It will, indeed, be lamentable if the lessons so often received, and so lately repeated, on the subject of submarine cables should be so ill understood, or so wilfully misapplied, as that another should be added to the long list of failures which now unhappily disgraces the annals of electric science.

With the account before us of what took place during the laying of the Persian Gulf cable—the separation, I mean, of the copper wire, while the spiral iron wires and the gutta-percha remained perfect—what are the inferences to be legitimately drawn?—to what conclusions do the circumstances inevitably lead us?

I am, I confess, at a loss to conceive how any man calling himself an engineer can avoid seeing that he has again received practical evidence of the truth of the theory so long brought to the notice of your readers, that in any structure where straight lines and spirals are found with a soft, or comparatively soft substance between them, the straight lines must bear the whole of the strain; the spirals in no way contribute to the strength. If compression of the comparatively soft gutta-percha or hemp can occur, then coincident elongation must be the result. There is no strength in any arch where the keystone is compressible. One would be disposed to imagine—one might even be inclined to affirm—that these propositions are self-evident. Why, then, is another £800,000 to be spent on a cable constructed on precisely these principles? Why are scientific men—men justly celebrated, one would suppose, for their general scientific knowledge—to be found supporting with the weight of their great names a cable which can only serve to exhibit the recklessness of contractors, and to exhaust alike the patience and the purses of telegraphic shareholders?

Is it not enough that the most unsuccessful undertaking in Europe, not, indeed, from any inherent defect in the magnificent structure, but from want of study or understanding the commercial and mechanical conditions of success—I refer to the Great Eastern—is it not enough that this should be joined to the next greatest failure, an Atlantic cable, by way of ensuring a magnified success? But we must be furnished with a cable such as I have described, such as has always hitherto failed, and such as no one in his senses can suppose will succeed because it measures an inch and a tenth in diameter, instead of five-eighths of an inch. I do write with strong feeling, for I can scarcely view such errors with patience; but on this subject at least I am not open to the reproach of taking an interested view. I have no cable of my own to propose, nor have I any interest other than that of the public to subserve.

It is not yet too late; the core is not yet subjected to the faithless compression of its weighty sheathing; and whether the said core be laid in its naked beauty, or straight steel wires be added to its outer strength, it will in either case, though not the best that could be made, be mechanically a more correct, statically a stronger cable, than it can ever be with the envelope now proposed, and I grieve to think approved by men who should have known better. Those who attempt to command success while they never seek to deserve it, need scarcely be surprised if disgraceful failure accompanies their every effort. Had the Persian Gulf cable been laid in 2,000 instead of 40 fathoms, we should now be lamenting another evidence of the truth of that which I here press on the attention of those interested—the shareholders—for there would have been little chance of raising it to effect the needful repair.

J. H. SELWYN.

TELEGRAPHIC NEWS.

THE DOUBLE-SPRING KEY.—Mr. Wm. Andrews, of the United Kingdom Telegraph Company, has recently introduced a very ingenious and efficient key for working the Pneumatic Relay. The arrangement is a substitute for the pump key, and is in fact an ordinary Morse with a double spring.

AN ELECTRIC LIGHT of unusual brilliancy was exhibited by Mr. Ladd, of Beak-street, London, on the top of St. Mary's-tower, Cambridge, during the recent visit of the Prince and Princess of Wales. The powerful voltaic battery was the one used for illuminating the Monument on the occasion of the marriage of their Royal Highnesses, March 10th, 1863. It would be interesting to know how far from Cambridge the light was visible.

VULCANIZED INDIA-RUBBER INSULATED WIRES.—A series of very interesting experiments upon the insulating capacities of a newly-designed and constructed core by Mr. William Hooper, of Pall-mall East and Mitcham Rubber Mills, were made on Thursday, the 16th inst., at Messrs. Reid Brothers' works, Wharf-road, City-road. The core was tested under a pressure of 6,700 lbs. on the square inch with the most satisfactory results. We are not informed, however, whether there were any *joints* in the length tested, as we have some doubts as to the permanency of *joints* made in vulcanized and virgin-rubber covered cores.

THE LATE EXPLOSION, LOSS OF LIFE, AND DESTRUCTION OF A TELEGRAPH STATION AT TRIPOLI.—Further particulars have been received relative to the late explosion of a Government powder magazine at Tripoli, on the 30th of May, by which more than 500 persons were at first said to have been killed, the greater portion consisting of Ottoman soldiers, in a barrack in the vicinity of the magazine. It appears from a later telegram, received by the Ottoman Consul-General at Malta from the Governor of Tripoli, that the number of victims was 150 only, that none of the population had, as first reported, sought refuge on board the shipping in the port, and that perfect tranquility prevailed among the people. Telegraphic communication had been temporarily suspended, from injury done to the station, and from the necessity of removing the instruments, which were covered with the débris.

THE INDIAN TELEGRAPH.—The *Calcutta Englishman*, of the 22nd April, says:—"Our Kurrachee correspondent said that Colonel Stewart intended returning to England soon, in order to arrange finally with the Sultan a convention for the use of the Turkish lines of telegraph. We further learn that Colonel Stewart will proceed to Constantinople first to carry out the details of the convention, which is to regulate the extent and description of control the English are to exercise over the Turkish lines. There is also a good deal to be done between Fao and Bagdad before the through line to England can be said to be in a satisfactory state. Nothing has yet been drawn up as to our control of the Turkish line, which commences at Bagdad, and nothing is to be done until Colonel Stewart reaches Constantinople. The cable has been laid down at Fao, and messages can be sent now to Europe in three days."—[We believe that Colonel Stewart, Sir Charles Bright, and the electrical and engineering staff, are expected to return to England about the 18th or 19th of the current month.—ED. T. J.]

TORPEDOES.—During the Chatham Siege Review, on the 11th instant, experiments were made with torpedoes, and the terrible effect is thus described:—"The besieged turned their attention to the boats, and sprung their first torpedo under water. These torpedoes, the most modern and most destructive engines of river warfare, were ranged in a line of six across the mouth of the creek. Some were made of tin cases, others were differently contrived on a new principle, on which it is unnecessary to be more explicit, and all were lit by the voltaic battery, carrying the spark through gutta-percha insulated wires into the centre of the charge. Though these torpedoes had been down a week in 30 feet of water, and contained charges varying from 100 lbs. to 160 lbs. of powder, yet not one failed to explode. The first, though a small charge, threw a great mass of water 60 feet into the air, and at this alarm all the boats drew rapidly away, as column after column of water and smoke rising to a towering height, and falling in a shower of foaming spray all over the creek, showed the imminence of the danger they had escaped. The last of the torpedoes fired was one containing 160 lbs. of powder, and the effect of this was apparently tremendous enough in force to have broken the back of a three-decker."

THE ATLANTIC TELEGRAPH COMPANY.—The steel of which the homogeneous wire for the Atlantic cable is being drawn by Messrs. Horsfall, of Birmingham, is being made by the Chillington Iron Company, of Wolverhampton. The first instalment of the wire was sent from Birmingham on Saturday last, *en route* for the works of Messrs. Glass, Elliot, & Co., at Greenwich. The wire will, at its thinnest point of tenuity (No. 13 guage) bear a strain of 1·040 lbs., according to the test of a machine which has been invented for the purpose by Mr. Deeley, Messrs. Horsfall's engineer. The wire, when brought into the works at Birmingham, from the rolling mills at Sheffield, measures about 200 yards per bundle, and is three-eighths of an inch in thickness. In Birmingham it has to pass through four drawings, by which it is reduced to No. 13 guage, or ·095 thick, and its length increased to 800 yards per bundle. After the drawing is over in Birmingham, the wire is boiled in oil before it is ready to be sent away from the works. The occasion of the despatch of the first instalment of the wire was one of considerable rejoicing at the works, and the thirteen railway trucks by which it was conveyed were drawn by horses decorated with ribbons and flowers.—[In the above paragraph, quoted from the *Engineer* of the 10th inst., we are informed that the wire at the thinnest point of tenuity (No. 13 guage) will bear a *strain* of 1·040 lbs., but we are not informed of the wire's contractile force after being subjected to various strains. The employment of steel wires applied spirally for the protection of the core in deep-sea telegraphs is a matter of considerable importance, as any one will find by reference to our own experiments on the tensile strength of cables. See Government Report of 1862.—ED. T. J.]

THE ELECTRIC VOTE REGISTER.—The Paris correspondent of *The Times* gives the following very interesting description of an electrical apparatus for recording the votes in the French Senate.—An experiment was tried on Tuesday at the Palace of the Luxembourg, in the presence of Baron Lacrosse, one of the Secretaries of the Senate, with an electrical apparatus, intended to replace the present mode of voting in the French Legislative Assemblies. The engineer who invented the apparatus began by placing 12 boxes, each provided with two finger keys, one white and the other black, on two benches. (The number of boxes is to be the same as the number of the members of the Assembly.) These boxes were connected by metallic wires, with what the engineer calls an indicating table, pierced with holes corresponding to the name of each of the voters. Two more holes, but larger, opening at the bottom of the table, are intended to give the addition of votes, for and against. This part of the apparatus is called the reckoner. The reckoner is moved by a button placed within reach of the President's hand. When the President announces that the ballot is to commence, each member of the Assembly presses the finger key, white or black, by extending his hand over his desk. A disc of the same colour instantly appears at the hole placed beside the name of the voter. When the President declares that the ballot is closed he touches the button placed under his hand, for the double purpose of preventing any further vote, and of setting in motion the machinery, which instantly performs the addition of the votes for and against. The Secretaries have then only to look at the reckoner and to transmit the numbers to the President. In case of a secret vote secresy is secured by an ingenious arrangement of the engineer, by which the vote is transmitted to any hole but that next the voter's name. The few persons who were admitted to be present at the experiment were greatly pleased with it.

TELEGRAPHY IN THE EAST.—A submarine line of telegraph is about to be carried out between India and Singapore by a private company, which has been in existence for some time, and was established to arrange a complete system of telegraphs between India, Singapore, China, and Australia. The India and Singapore telegraph will be the first line undertaken. The length of this line is 1,400 statute miles, or about 115 miles shorter than the Malta and Alexandria telegraph, which was laid three years ago. The cable between India (Rangoon) and Singapore will be laid in a depth not exceeding 50 fathoms, and this circumstance will enable it to be fished up without any difficulty for repairs, and will ensure the permanence of the work. Two intermediate stations will be established, one of which will be at Penang, and the longest section will not exceed 600 miles, which is shorter by 100 miles than the longest section on the Malta and Alexandria line. The proposed line will be a continuation of the telegraph to India, which will be shortly completed, but it has a value quite independent of the completion of telegraphic communication between this country and India. Singapore is one of the largest shipping ports of the world, and a submarine line is essentially adapted to accomodate ships in consequence of the proximity of the stations to the sea. The establishment of direct telegraphic communication between India and Singapore is alone of the utmost value, and will ensure a large return; such a line of telegraph will also reduce the distance to Hong-Kong, Shanghae, Batavia, and the Straits of Sunda, through which so large an amount of shipping passes on its way to and from China, to little more than the time occupied by the mail steamers between Singapore and those several points. The remunerative character of the Malta and Alexandria line gives good promise that the India-Singapore telegraph will be also highly profitable. It is a remarkable circumstance that a submarine cable can also be laid between Singapore, Hong-Kong, and Shangae, and also for the greater portion of the distance between Singapore and Australia, in a depth not exceeding 50 fathoms. Nothing can be more favourable than the sea bottom and depth in those seas, as shown on the Admiralty charts, for the development and permanence of submarine telegraphy.

ROYAL ASTRONOMICAL SOCIETY.—Warren de la Rue, Esq., F.R.S., President of the Royal Astronomical Society, entertained a numerous and distinguished company at a *soirée*, at Willis's Rooms, on Saturday evening, the 11th instant. Among the company present were his Eminence Cardinal Wiseman, Bishop Colenso, the Dean of Chester, the Earl of Caithness, Lord Wrottesley, Lord Wensleydale, the Master of the Mint, Sir John Bowring, Sir Charles Locock, Sir Henry Holland, Admiral Sir George Sartorius, Sir E. Belcher, Sir A. S. Waugh, Sir Roderick Murchison, Sir Henry Rawlinson, the Right Hon. C. P. Villiers, M.P., &c. A large number of most interesting astronomical and other articles were exhibited, and during the evening afforded much pleasurable scrutiny. The President (Mr. de la Rue) exhibited photographs and drawings of the planets, a photograph of the eclipse, a photograph of the moon, 38 inches in diameter, and a collection of Turner's paintings. From the Astronomical Society some exceedingly interesting articles were sent. The Kew Observatory sent, amongst other articles, the glasses and original mountings of Huggens's

serial telescope (120 feet focus), and the model of the tower which Mr. de la Rue proposed erecting there in order to view Saturn through glasses. The London Institution, the Rev. Professor Selwyn, Professor Phillips, of Oxford; T. W. Burr, Esq., Rev. F. Howlett, Alex. S. S. Herschel, Esq., J. Nasmyth, Esq., C. W. Siemens, Esq., E. W. Cooke, Esq., A. M'Cullum, Esq., Owen Jones, Esq., Vice-President of Society of Architects; H. Warren, Esq., President of New Society of Painters in Water Colours; Messrs. Lloyd Brothers, Henry Swann, Esq., Thos. Woolner, Esq.; Morton Edwards, Esq.; S. M. Drach, Esq.; Dr. Lee; Admiral Smyth; E. W. Brayley, Esq., Henry F. Holt, Esq.; C. V. Walker, Esq.; Hamilton Field, Esq.; W. Tite, Esq., M.P.; Captain George, R.N.; J. Hart, Esq.; J. T. Barber, Esq.; and H. Perigal, jun., Esq., furnished very interesting articles in the way of telescopes, autographs, astronomical and other diagrams, meteorites, and models, as well as paintings, photographs, instruments, &c. Professor Wheatstone supplied a pair of indicating instruments and a magnetic typo-printing telegraph. The latter was much admired, as being a very useful and ingenious contrivance. Lieutenant-Colonel W. F. De la Rue's piece of the flagstaff of Fort Sumter, a fragment of a Parrott-shell fired against the fort, and brick dislodged from the fort (authenticated by General Beauregard's autograph) were much sought after; as was also Professor Roscoe's new magnesium lamp, which has been employed for the production of photographic portraiture by night. Dr. Giles exhibited some original sketches by Thackeray, made in 1832, before the lamented author was known to fame. The directors of the Patent Electric Signal Company exhibited their recently patented invention for indicating, by means of electricity, the exact position of distant or auxiliary signals, points, and switches. C. Frodsham, Esq., exhibited a number of astronomical clocks, chronometers, watches, &c. A telescope of new construction, on Gauss's principle, and embodying the seven desiderata set forth by Gauss, was exhibited by Dr. Steinheil, of Munich. A series of microscopes, exhibited by Messrs. Smith, Beck, & Beck, Messrs. Powell & Lealand, J. How, Esq., and T. Ross, Esq., were much in requisition, and elicited a good deal of admiration. S. Heighly, Esq., Octavius Morgan, Esq., C. Heisch, Esq., A. F. Claudet, Esq., J. F. Abel, Esq., John Young, Esq., Professor Tennant, Dr. Wright, S. W. Silver, Esq., Henry Lowcock, Esq., W. D. Haggard, Esq., Richard Abbatt, Esq., Benjamin Scott, Esq., J. S. S. Glenny, Esq., Messrs. Mertz, Munich, E. Wheeler, Esq., Thomas Ross, Esq., W. Ladd, Esq., Messrs. Cooke & Sons, York, Messrs. Horne & Thornthwaite, Messrs. Elliott & Brothers, J. P. Casella, Esq., P. Adie, Esq., Messrs. Troughton & Simms, J. H. Dallmeyer, Esq., Messrs. Hopkins & Williams, J. Browning, Esq., and Mr. Silver, of the "India Rubber Works and Telegraph Cable Company," were amongst the other exhibitors. Some experiments with the electric light evoked general admiration.

MISCELLANEA.

Spectral Ray of Thallium Paralysed by that of Sodium.—It appears that if thallium be present in small proportions in a compound containing chloride of sodium, the action of the ray characteristic of the latter is so powerful that the thallic ray remains unperceived. Hence, although the thallic ray be not observed in the solar spectrum, it by no means follows that the metal itself does not exist in the sun. This is a fact of great importance, not only in regard to ordinary chemistry, but as it bears on toxicology. For in an analysis (spectral) of the animal tissues or liquids, one is certain to find chloride of sodium in abundance, and therefore, were thallium present in small proportions, it would escape detection by this method. If it be required to examine mineral waters and such-like for thallium, it will be necessary to separate the metal in the first instance from the excess of soda; this may be done by one of the methods pointed out by M. Lamy, viz., either depositing it on zinc, or reducing it by galvanic means, or by precipitating it with sulphide of ammonium or iodide of potassium.

Gas Engines in France.—*Le Petit Journal*, of Paris, in a long article sparkling with French vivacity, on the uses of the Moteurs Lenoir, states that large numbers of these engines are employed for various purposes in Paris. The writer discourses thus:—"We have been to the Grand Hotel. It is not far; and we have examined the Moteurs Lenoir labouring for the comfort of the thousand travellers lodged in that caravansery of the great world. There is one which supplies all of the water for the hotel, from the cellar to the garret; another raises the dishes from the basement to the fourth story; another turns the machine for breaking the ice and cooling the sillery, the cliquot. Six men were formerly required, half naked and panting, to operate this machine which the little motor turns like a top. Another motor raises to their respective stories the travellers comfortably seated in a saloon disposed for this perpendicular voyage; another raises the baggage, and all this without noise, without fire, without smoke. The complaisance of the mechanician charged in the hotel with all of the mechanical service, enabled us to see how these motors put themselves in operation, and stop themselves instantaneously. What gives to them the movement—origin of their power? It is gas, which an electric spark inflames in the body of the piston. That gas—it is that which the immense *Compagnie Parisienne* distributes in all the city. It comes to feed the Lenoir motor as it would feed a burner or a stove."

Formation of Iron by Metallurgical Insects.—A Swedish naturalist, M. Sjogreen, has recently published a curious memoir on an iron mineral which is, he contends, the direct work of infusorial animalculæ, living in the midst of sweet water. This ferruginous mineral, known under the name of lake ore, is sufficiently abundant in certain Swedish water-courses to be submitted to treatment in ironworks. The memoir of M. Sjogreen was composed with more especial reference to certain specimens of minerals shown in the International Exhibition of London, in 1862. A lake in his neighbourhood had fallen much below the ordinary level, and enabled him to follow the evolution of the mineral. The bottom of the lake was in part laid bare, from the extreme lowness of the water, but there still existed depressions filled by water, and occupied by insects or infusorial metallurgists. These depressions presented a strange and marvellous spectacle. At the bottom of one, which was somewhere about three feet in diameter, small creatures of different sizes agitated themselves on the mineral, some being visible to the naked eye, while the others were so small that without a magnifying glass it would have been impossible to discern them. All were actively engaged in enclosing themselves in a metallic envelope, just as the caterpillar encases itself in a cocoon, and the work seemed to the spectator to be effected in a systematic manner. The iron exists in the waters in a soluble state, or rather, the waters borrow it from the surrounding lands. Lake mineral is produced with considerable rapidity; in certain lakes from which there had been extracted twenty-six years previously all the metallurgical crop, there was again found after this yield a fresh harvest of almost equal abundance.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1412. H. A. Bonneville, improvements in telegraphic printing apparatus.—A communication.

1458. J. McElroy, improvements in electro-telegraphic apparatus, and in instruments for preparing the transmission of electric telegrams.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1308. G. Schaub, an improved mode of transmitting currents of electricity for telegraphic purposes.

1345. P. Deeley, a new or improved machine for testing the strength of wire.

PATENTS SEALED.

3245. J. G. Rowe, improved means of communication between the guard and engine-driver of a railway train.

3208. F. N. Gisborne, improvements in the means of communicating signals on board ship, on railways, and for other purposes.

3252. F. Walton, improvements in telegraphic cables.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6	per lb.
Good re-boiled	1/6 to 1/8	„

India Rubber.

Para, first quality	1/10 to 1/11	„
second „	1/7 to 1/8	„
third Negro-head	1/2 to 1/3	„
Java and Penang	1/4 to 1/5	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph	100	99 to 102	—
100	Submarine Telegraph, scrip.	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph	3	$1\frac{1}{2}$ to 1 dis,	—
10	Mediterranean Extension Tel.	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co.	all	1 to 2	—
20	Telegraph Maintenance Co.	4	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—

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JOINTS IN THE INSULATED CORES OF SUBMARINE CABLES.

IN conversation recently with a gentleman who has ever manifested a lively interest in submarine telegraphy, the difficulty of effectually splicing lengths of rubber insulated cable came under consideration, when, without the remotest intention of perpetrating a joke, our friend remarked, "Well, as it appears inevitable that we must have 'joints,' every precaution should be taken to have them 'well done.'" The importance of the observation has been fully borne out by the lamentable failures which have been found to result from defective insulation, manifesting itself in the jointings after the submersion of cables. Within the last few years numerous materials have been proposed for insulating purposes, and have been subjected to electrical tests, mostly in short lengths, with the most favourable results. We have had on several occasions to investigate the insulating properties of such materials, and more especially with regard to the practicability of making efficacious joints therein.

In the Report of the Submarine Telegraph Committee, speaking of india-rubber covered wire, it is stated that "the joints of the spirally twisted slip should closely adhere, otherwise in every place of imperfect contact a fault would be generated." As an illustration of this fact, the following account of some recent tests will be found both interesting and instructive.

The length of cable tested was about sixteen miles, coiled and immersed in water in a large well or tank. The construction of the cable is described as follows:—The copper wire or conducting strand, about 270 lbs. per statute mile, covered or insulated with 165 lbs. per statute mile of india-rubber; the first coating being of pure virgin rubber, and the remaining coatings of masticated rubber, and the complete core served with the best Russian hemp, saturated with Stockholm tar, then furnished spirally with twelve No. 8 galvanized iron wires.

The battery employed for the electrical tests consisted of 120 elements of Daniell's, and the instrument used was Mr. W. T. Henley's standard galvanometer, a very sensitive and accurate instrument. One end of the cable being insulated, and the other attached to the binding screw of the galvanometer, and through it to the copper pole of the battery, the zinc pole being in connection with earth, the loss of insulation, as indicated on the instrument, was 7·5° with the copper pole, and with the zinc pole, 21°, increasing in two minutes to 28°; the poles were reversed, when the copper gave a loss of 9°, decreasing in one minute to 8°.

The battery power was then reduced to 60 elements. The loss on the zinc was 14°, and on the copper 9°, and when reduced to 30 elements, the loss on zinc was 4°, and on copper 3°. After a short interval the following additional tests were made:—

30 elements.	°
Copper to cable	2 loss
Zinc to cable	2·75
60 elements.	°
Zinc to cable	6 loss
Copper to cable	3·25
120 elements.	°
Zinc to cable	56·5 loss
Copper to cable	21
60 elements.	°
Copper to cable	10·75 loss
Zinc to cable	53·

The electrolytic action of the current upon the imperfect joints is apparent, and no doubt, had the experiments been continued, the destruction of the insulation would have been complete, and irremediable had the cable been submerged in great depths. When the same cable was tested in one mile lengths the aggregate loss on twenty miles, with 504 elements, did not exceed ·3°, as will be found from the following table published at the time:—

Date of Testing.	Temperature of Water.	Number of length (1 mile).	Loss of Insulation in Vacuo.	Loss of Insulation under Pressure.
	Degs.		Degs.	Degs.
July 29, 1862	74	1	0 ·25	·5
"	"	2	0	0
"	"	3	0	0
August 5	"	4	0	0
"	"	5	0	0
"	"	6	0	0
"	"	7	0	0
August 13	"	8	0	0
"	"	9	0	0
"	"	10	0	0
"	"	11	0	0
"	"	12	0	0
"	"	13	0	0
"	"	14	0	0
"	"	15	0	0
August 15	"	16	0	0
"	"	17	0	0
"	"	18	.5	0
"	"	19	·25	·25
August 20	"	20	0	0

We propose now to place before our readers the opinion of a gentleman of great practical experience, on electrolysis. Mr. C. F. Varley, in his evidence before the Submarine Telegraph Committee, gives the following instances which came under his observation. He says:—

"I have frequently observed this peculiarity of the positive current sealing up a fault; it acts in different cases in different ways. In sea water it oxidizes the copper wire, and also produces a subchloride of copper, which renders the surface non-metallic, and to a certain extent insulating. The current escaped, and this fault gradually got worse and worse, until it became what we technically term dead earth—that is, so much of the current flowed into the ocean, that we could get no intelligible signals through. Some years since a wire between the Admiralty and our Strand office was three times reported by our man who repairs the street wires to be good, and as often reported bad by myself. I made an appointment with him to test the wire. I found that he had tested with the negative. That wire was a peculiar instance of the effect which very frequently occurs, but it was very rapid, so rapid that the moment the positive current was applied the wire instantly insulated, and the moment the negative was applied it instantly gave way, and became dead earth. As we reversed the current the wire was either insulating or giving earth. Ordinary gutta-percha covered wire often shows to a small extent the same action; its insulation always improves slightly under the influence of a powerful positive current; and, generally speaking, becomes bad again to a certain extent with the negative current. I am very much inclined to attribute this phenomenon to the existence of water in the pores of the gutta-percha, for gutta-percha, as at present manufactured, is not free from moisture. Wherever you get this variation, it is, in my opinion, an indication of electrolytic action going on."

We intend to return to this subject in a future number.

ON A MAGNETIC EXPERIMENT.

THE 1863-4 session of the Royal Institution was brought to a close on the 10th instant by a lecture with the above title by Professor Tyndall. Professor Tyndall spoke as follows:—"There are two words which are very often employed in scientific writings—matter and force. The definition of each involves the conception of the other. We know nothing of force save through its operations upon matter, and we know nothing of matter save through the manifestations of its force. The nature of any force must therefore be sought in the material changes which it is competent to produce. Some years ago I felt a great interest in the subject of magnetism, and in those years I devised an apparatus to enable me to investigate certain mechanical effects which accompany the act of magnetization. I wished to apply this apparatus to diamagnetic bodies as well as paramagnetic ones—to bodies such as bismuth, as well as to bodies such as iron. I intend this evening to show you the action of this instrument, and to give, if I can, some explanation of the experiments of others which have been confirmed by my own.

"Let us pass quickly in review the excitation of this wonderful power of magnetism. Here is a strong horseshoe magnet set upright, and here is a bent bar of steel, whose arms are the same distance apart as those of the horseshoe magnet. I draw the bent steel bar over the ends, or the poles, as they are called, of the magnet. It suddenly obtains the power of attracting this iron keeper and holding it fast. I reverse the stroke of the steel bar: its virtue has now disappeared; it is no longer competent to attract the keeper. I continue the stroke of the steel bar in the last direction, and now it is again competent to attract the iron: thus I can at will magnetize and demagnetize this bent piece of steel.

"Here is a noble, permanent magnet constructed by Logemann, of Haarlem, and competent to carry a great weight. Here, for example, is a dish of iron nails which it is able to empty. At the other side of the table you observe another mass of metal, bent like the Logemann magnet, but not, like it, naked. This mass, moreover, is not steel, but iron, and it is surrounded by coils of copper wire. It is intended to illustrate the excitement of magnetism by electricity. At the present moment this huge bent bar is so inert as to be incapable of attracting a single grain of iron. I now send an electric current through the coils that surround it, and its power far transcends that of the steel magnet on the other side. It can lift fifty times the weight. It holds a 56 lb. weight attached to each of its poles, and it empties this large tray of iron nails when they are brought sufficiently near it. I interrupt the current; the power vanishes, and the nails fall.

"Now the magnetized iron cannot be in all respects the same as the unmagnetised iron. Some change must take place among the molecules of the iron bar at the moment of magnetization. And one curious action which accompanies the act of magnetization I will now try to make sensible to you. Other men laboured, and we are here entering into their labours. The effect I wish to make manifest was discovered by Mr. Joule,* and was subsequently examined by De la Rive and Wertheim, Marian, Matteucci, Wartmann. It is this. At the moment when the current passes through the coil surrounding the electro-magnet, a clink is heard emanating from the body of the iron, and at the moment the current ceases a clink is also heard. In fact, the acts of magnetization and demagnetization so stir the atoms of the magnetized body that they in their turn can stir the air and send sonorous impulses to our auditory nerves.

"I have said that the sounds occur at the moment of magnetization, and at the moment when magnetization ceases; hence if I can devise a means of making and breaking in quick succession the circuit through which the current flows, I can obtain an equally quick succession of sounds. I do this by means of a contact-breaker which belongs to a Ruhmkorff's induction coil. Here is a monochord, and a thin bar of iron stretches from one of its bridges to the other. This bar is placed in a glass tube, which is surrounded by copper wire. I place the contact-breaker in a distant room, so that you cannot hear its noise. The current is now active, and every individual in this large assembly hears something between a dry crackle and a musical sound issuing from the bar in consequence of its successive magnetization and demagnetization.

"Hitherto we have occupied ourselves with the iron which has been acted upon by the current. Let us now devote a moment's time to the examination of the current itself. Here is a naked copper wire, which is quite inert, possessing no power to attract these iron filings. I send a voltaic current through it; it immediately grapples with the filings, and holds them round it in a thick envelope. I interrupt the current, and the filings fall. Here is a compact coil of copper wire which is overspun with cotton to prevent contact between the convolutions. At present the coil is inert; but now I send a current through it; a power of attraction is instantly developed, and you see that it is competent to empty this plate of iron nails.

"Thus we have magnetic action exhibited by a body which does not contain a particle of the so-called magnetic metals. The copper wire is made magnetic by the electric current. Indeed, by means of a copper wire through which a current flows, we may obtain all the effects of magnetism. I have here a long coil, so suspended as to be capable of free motion in a horizontal direction; it can move all round in a circle like an ordinary magnetic needle. At its ends I have placed two spirals of platinum wire which the current will raise to brilliant incandescence. They are glowing now, and the suspended coil behaves in all respects like a magnetic needle. Its two ends show opposite polarities; it can be attracted and repelled by a magnet, or by a current flowing through another coil; and it is so sensitive that the action of the earth itself is able to cause it to set north and south.

"There is an irresistible tendency to unify in the human mind; and, by aid of imagination, we transfer the conceptions of the visible world to the invisible. In accordance with our mental constitution we desire to reduce phenomena which are so much alike to a common cause; and hence the conception of the celebrated Ampère that a magnet is simply an assemblage of electric currents. Round the atoms of a magnet Ampère supposed minute currents to circulate incessantly in parallel planes; round the atoms of common iron he also supposed them to circulate, but in all directions—thus neutralizing each other. The act of magnetization he supposed to consist in the rendering of the molecular currents parallel to a common plane, as they are supposed to be in the case of the permanent magnet.

"This is the celebrated theory of molecular currents propounded by Ampère. You observe it consists in the application of conceptions obtained from sensible masses of matter to insensible or atomic masses. Let us follow out this conception to what would appear its legitimate consequences. I have said that we obtain both attractions and repulsions from electric currents: all these effects are deduced from one law, which is, *that electric currents flowing in the same direction attract each other, while, when they flow in opposite directions, they repel each other*. Let me illustrate this law rapidly. Here are two flat coils suspended facing each other, and about eight inches apart. I send a current through both, causing it to flow through them in the same direction; the coils instantly clash and cling together in virtue of their mutual attraction. I now reverse the current through one of them, and they fly a yard asunder, in virtue of their mutual repulsion. And now one of them twists its suspending wire so as to turn its opposite face to the other coil; the currents are now again in the same direction, and the coils clash and cling as in the first instance. Imagine, then, our molecular currents flowing round the atoms of this iron bar in planes perpendicular to the length of the bar. From the law just enunciated we should infer the mutual attraction of those currents; and from this attraction we should be disposed to infer the *shortening* of the bar at the moment of magnetization. Here, for example, is a coil of copper wire suspended vertically; the end of the coil dips into this little basin of mercury. From a small voltaic battery behind I send a current through the coil; and, because it passes in the same direction through all its convolutions, they attract each other. The coil is thereby shortened; its end quits the mercury with a spark; the current ceases; the wire falls by its own gravity; the current again passes, and the wire shortens as before. Thus you have this quick succession of brilliant* sparks produced by the shortening of the wire and the interruption of the current as it quits the mercury.

"Is it a fact, then, that an iron bar is *shortened* by the act of magnetization? It is not. And here, as before, we enter into the labours of other men.

"Mr. Joule was the first to prove that the bar is *lengthened*. Mr. Joule rendered this lengthening visible by means of a system of levers and a microscope, through which a single observer saw

* The sound, I find, was first noticed by Mr. Page.—I. T., 16th June.

* Rendered brilliant by the introduction of a coil of wire and a core of soft iron into the circuit.

the action. The experiment has never, I believe, been made before a public audience; but the instrument referred to at the commencement of this lecture will, I think, enable me to render this effect of magnetization visible to everybody present.

"Before you is an upright iron bar, two feet long, firmly screwed into a solid block of wood. Sliding on two upright brass pillars is a portion of the instrument which you see above the iron bar. The essential parts of this section of the apparatus are, first, a vertical rod of brass, which moves freely and accurately in a long brass collar, the lower end of the brass rod resting upon the upper flat surface of the iron bar. To the top of the brass rod is attached a point of steel, and this point now presses against a plate of agate, near a pivot which forms the fulcrum of a lever. The distant end of the lever is connected, by a very fine wire, with an axis on which is fixed a small circular mirror. If the steel point be pushed up against the agate plate, the end of the lever is raised; the axis is thereby caused to turn, and the mirror rotates. I now cast a beam from an electric lamp upon this mirror; it is reflected in a luminous sheaf, fifteen or sixteen feet long, and strikes our screen, there forming a circular patch of brilliant light. This beam is to be our index; it will move as the mirror moves, only with twice its angular velocity; and the motion of the patch of light will inform us of the lengthening and shortening of the iron bar.

"I employ one battery simply to ignite the lamp. I have here a second battery to magnetize the iron bar. At present no current is passing. I make the circuit, and the bright image on the screen is suddenly displaced. It sinks a foot. I break the circuit: the bar instantly shrinks to its normal strength, and the image returns to its first position. I make the experiment several times in succession: the result is always the same. Always when I magnetize the image descends, which declares the lengthening of the bar; always when I interrupt the current, the image rises. A little warm water projected against the bar produces the same effect as magnetization. This, I believe, is the first time that this action has been seen by a public audience.

"I have employed the same apparatus in the examination of bismuth bars, and, though considerable power has been applied, I have hitherto failed to produce any sensible effect. It was at least conceivable that complementary effects might be here exhibited, and a new antithesis then established between magnetism and dia-magnetism.

"No explanation of this action has, to my knowledge, been offered, and I would now beg to propose one which seems to be sufficient. I place this large flat magnet upon the table, over it I put a paper screen, and on the screen I shake iron filings. You know the beautiful lines in which these filings arrange themselves—lines which have become classical from the use that has been made of them in this Institution; for they have been guiding threads for Faraday's intelligence while exploring the most profound and intricate phenomena of magnetism. These lines indicate the direction in which a small magnetic needle sets itself when placed on any of them. The needle will always be a tangent to the magnetic curve. A little rod of iron, freely suspended, behaves exactly like the needle, and sets its longest dimension in the direction of the magnetic curve. In fact, the particles of iron filings themselves are virtually so many little rods of iron, which, when they are released from the friction of the screen by tapping, set their longest dimensions along the lines of force. Now, in this bar magnet the lines of force run *along the magnet itself*, and, were its particles capable of free motion, they would also set their longest dimensions parallel to the lines of force—that is to say, parallel to the length of the magnet. This, then, is the explanation which I would offer of the lengthening of the bar. The bar is composed of irregular crystalline granules, and, when magnetized, these granules tend to set their longest dimensions parallel to the axis of the bar. They succeed partially and produce a microscopic lengthening of the bar, which, suitably magnified, has been rendered visible to you.*

"Perhaps you do not see the magnetic curves from your present position, but I will enable you to see them. I have here an electric lamp turned on its back, and from it a vertical cylinder of light now issues. Over the aperture of the lamp I place two small bar magnets, enclosed between two plates of glass. The vertical beam is received upon a looking-glass which reflects it on to the screen. In the path of this reflected beam I place a lens, and thus obtain upon the screen a magnified image of the two small bar magnets. And now I sprinkle this fine iron sand on the plate of glass, and you see how it arranges itself under the operation of the magnets. A most beautiful display of the magnetic curves is now before you. And you observe, when I tap the glass, how the particles attach themselves by their ends, and how the curves close in upon each other. They try to attach themselves thus in the solid iron bar: the consequence is that the longitudinal expansion is exactly counterbalanced by the transverse contraction, so that the *volume* of the bar remains unchanged.

"But can we not bring a body with moveable particles within an electro-magnetic coil? We can. And I will now, in conclusion, show you an experiment devised by Mr. Grove, which bears directly upon this question, but the sight of which, I believe, has hitherto been confined to Mr. Grove himself. At all events, I am not aware of its ever having been made before a large audience. I have here a cylinder with glass ends, and it contains a muddy liquid. This muddiness is produced by the magnetic oxide of iron which is suspended mechanically in the liquid. Round the glass cylinder I have coiled five or six layers of covered copper wire; and here is a battery from which a current can be sent through the coil. First of all, I place the glass cylinder in the path of the beam from our electric lamp, and by means of a lens cast an image of the end of the cylinder on the screen. That image at present possesses but feeble illumination. The light is almost extinguished by the suspended particles of magnetic oxide. But, if what I have stated regarding the lines of force through the bar of magnetized iron be correct, the particles of the oxide will suddenly set their longest dimensions parallel to the axis of the cylinder, and also in part set themselves end to end when the current is sent round them. More light will be thus enabled to pass; and now you observe the effect. The moment I establish the circuit, the disc upon the screen becomes luminous; I interrupt the current, and gloom supervenes; I re-establish it, and we have a luminous disc once more.

"The apparatus, as I have stated, was really invented to examine whether any mechanical effect of this kind could be detected in diamagnetic bodies; but hitherto without result. And this leads me to remark on the large ratio which the failures of an original inquirer bear to his successes. The public see the success—the failure is known to the inquirer alone. The encouragement of his fellow-men, it is true, often cheers the investigator, and strengthens his heart; but his main trials occur when there is no one near to cheer him, and when, if he works aright, he must work for duty and not for fame. And this is the spirit in which work has been executed in this Institution, by a man who has, throughout his life, turned a deaf ear to such allurements as this age places within the reach of scientific renown; and it behoves every friend of this Institution to join in the wish that *that* man's spirit may continue to live within its walls, and that those who come after him may not shrink from his self-denial while endeavouring to merit a portion of his fame."

* My assistant, Mr. Barrett, has just drawn my attention to a paper by M. De la Rive, in which this explanation is given. To him, therefore, belongs the entire credit of it.—J.T., June 18.

TELEGRAPHY IN TURKEY.

In a letter from Constantinople, dated 9th June, the correspondent of the *Daily Telegraph* thus adverts to the condition of the telegraph in the Ottoman dominions:—

"According to the information received here, the opening of the telegraph through to India will very shortly take place. As very little appears to be known as to the actual condition of the telegraphic service in this country, it may be opportune to give some particulars about it. Communication between the Ottoman capital and Western Europe passes through Vienna. From that city to Constantinople there are two distinct lines, one passing by Semlin and Belgrade to Adrianople, the other by Toultscha, Kustendjie, and Varna. There is a third line to Adrianople by Bucharest. By the opening of the submarine line between Avlona and Otranto, in Italy, the Turkish telegraph service will be in direct correspondence with the West, without going through Servia or the Moldo-Wallachian Principalities, where, at present, every conceivable obstruction is offered to the transmission of messages. Great as the disadvantages arising from this may be, they are but of trifling importance compared with the manner in which the Turkish telegraph service is itself performed. The original construction of the lines was of the most defective description, the materials used being very inferior. The tract of country chosen was selected apparently because of its presenting the greatest difficulties; since it is impossible for any proper supervision to be exercised as to the condition of the wires in severe weather, the lines passing over the steepest and most inaccessible hills, and

through valleys which might altogether have been avoided by the exercise of ordinary attention. This state of things is made worse by a very inadequate inspection, by men who are both too few in number, wretchedly paid, and generally incompetent. There is further to be considered the very frequent and arbitrary occupation of the wires by the Government, both on the Asiatic and European sides, interrupting, on many occasions, business of the most pressing nature, for the transmission of some trivial communication, which would lose nothing by a short delay. It may be imagined that, as the service is in the hands of Government, much depends upon the director-general of the department. Unfortunately, this official is in the unenviable position of holding office on such a poor tenure that it may be said he has a daily apprehension of being turned out and replaced by one of those numerous intriguers who swarm about the cabinets of the Ministers, or work through the more effectual influence of the Harem—the great bane of the country. The present director-general, Dihran Bey, an Armenian, is a weak vacillating man, appears to live in constant fear of causing trouble to the Turkish authorities, and is aware of their jealousy.

"The distance from this to Bagdad is 1,330 miles, and from the latter to Bussorah, where our Indian submarine line begins, 400 miles. From this city to Avlona the distance is 706 miles, making a total of 2,436 miles which the Indian messages will have to pass through Turkey. The lines from this to the other European Turkish frontier stations are—to Nissa, 440 miles; Rustchuk, 340; Toulcha, 355. It is probable that the line viâ Avlona will be the one selected for the Indian messages, both from its being more direct and avoiding the inconvenience already referred to. But, whatever prospect there may be of the regular working of the European line, it is very different with the Asiatic section from Scutari to Bussorah. The whole of this distance is entrusted to the inspection of four persons, two of whom are Englishmen, who, from the immense distance they have to traverse, even with the present limited work, find it impossible to keep the line in good order. Caretakers (chaouses,) each of whom has to provide and keep a horse out of his pay of 300 piastres (£2 14s.) per month, and whose beats extend to a two-hours' ride, have the watching of the wires, but are not able to repair damages. The chiefs of stations, and all other employés in Asia, are Turks, whose lazy habits and incompetency need not be wondered at when the smallness of their pay is considered; so there is every reason to apprehend that our Indian service is likely to be seriously retarded by depending upon such men. It has been proposed to the Turkish Government to employ a larger staff of European inspectors and electricians, but the natural jealousy of employing foreigners, in preference to their own subjects, stands in the way. The course the India Office ought to have taken, and which they will be obliged to come to eventually, was to obtain a concession for a separate wire from Bussorah to Avlona for the exclusive use of the India service. The advantages of such an arrangement are manifold, as the perfect control which would be thus secured would ensure despatch, regularity, and correctness; while to allow the service to remain in Turkish hands will only involve a serious amount of confusion. The India Office appears to have been at some loss how to act. Instead of securing as agents—to look to the efficiency of the service—persons acquainted with the country, its language, customs, and people, gentlemen have been sent out with the anomalous official designation of traffic managers—a post which the Turks cannot understand the nature of, from the fact that the officials in question will not have the slightest control over or connection with the traffic. A better course to pursue would have been to have endeavoured to employ, instead of these persons, who have no other qualification than their knowledge of some European language and electrical manipulation, the best local available means. For the direction of this service no better selection could have been made than Mr. O'Conner, the present able director of the Ottoman European telegraph service here. His long experience of the country, together with his fitness in every other respect, would have enabled him to organise telegraphic communication with India, so far as Turkey is concerned, vastly more efficient than it will be. I may mention, as proof of Mr. O'Connor's administrative ability, a fact that is of no slight interest. Some time since he was appointed to the charge of a part of the Asiatic line, when his post as director of the European service was filled successively by two persons, under whose mismanagement the service fell into the direst disorder, the employés becoming so corrupt that there was no longer any dependence to be placed on the secrecy which, of course, is essential in the transmission of messages. Matters went on thus to so flagrant an extent, that public indignation was aroused, and the Government re-appointed Mr. O'Connor to the directorate; in less than a month he effectually put down the corruption of the employés, rendered the service efficient, and restored public confidence. Such a man, possessed of energy, tact, thorough knowledge of the country, and how to manage its people, would, as agent for the India Office in this country, have been worth a host of the nondescript traffic managers sent out with no defined idea as to what they are to do. Already a "difficulty" has arisen. Mr. W. L. Courtenay, the India Office "traffic manager," recently arrived here, applied for the use of an office in the building occupied by the European telegraph department; this was refused, and one offered at the Scutari station, on the Asiatic side of the Bosphorus. Of course this has been declined, and so the traffic manager's office is opened in his private house, situated at an inconvenient distance from the other offices. At the Bagdad end of the line we are likely to have less cause of complaint, as our Consul-General there, Colonel Kemball, C.B., who is to have a special supervision of the service in that quarter, may be depended upon to see things go right.

"While on the subject of the Turkish telegraph, I may mention that some time since an application was made by Mr. Reuter to farm the European line, but the Porte declined both his and other offers. The matter has been again revived, and a renewed attempt is now being made to lease the line. Although this may be considered as a mere matter of internal policy, it is not probable that it will be favourably looked upon by the European powers. The impression in well-informed circles is, that the Porte will now, as before, decline to entrust the telegraph into foreign hands."

THE PERSIAN GULF TELEGRAPH EXPEDITION.

Her Majesty's steamer Coromandel, commanded by Lieutenant G. O. B. Carew, I.N., the senior Bombay marine officer with the above expedition, arrived in Bombay harbour on the 20th inst., with Lieut.-Colonel Patrick Stewart, R.E., the Director General of the Government Telegraph to India, and Sir Charles Bright, of the eminent engineering firm of Bright and Clark, each accompanied by the majority of his staff; that of Colonel Stewart consists of Captain Colvin Stewart, and Messrs. Brashes and Ponsonby Adair. Commander Bradshaw, R.N., of her Majesty's steam frigate Severn, and Mr. A. P. Young, of her Majesty's late Indian navy, who have been engaged during the laying of the submarine cable in preparing a very accurate chart of its course and position, have remained in Kurrachee to complete the chart, without which any repairs which the cable may hereafter require could scarcely be executed. Sir Charles Bright's staff consists of Messrs. Webb, Laws, Lambert, Woods, Alexander, Mosely, Donovan, and Crooks.

As our readers are already aware, the work for which the Persian Gulf expedition was sent out has been most successfully completed. A submarine telegraph cable has been laid from Kurrachee westwards along the Mekran coast of Beeloochistan, across the Gulf of Oman, up Malcolm's Inlet to Mussendom, over the isthmus called by the surrounding inhabitants Muklub, then submerged again on the other side, carried through the Elphinstone Island Repeating-station, and down Elphinstone Inlet to the Persian Gulf, along the bottom of which it creeps to Bushire, just "puts in an appearance" there, and starts off again to the Khor-ab-Dallah at the head of the Gulf, whence it wallows in the mud up to Fao on the Shat-el-Arab, the broad stream by which the Euphrates and Tigris discharge their waters in common into the Persian Gulf. At Fao the cable terminates in an office on board the hulk Hyderabad, the Turkish Government having failed to fill its engagement to have a building erected there before the arrival of the cable.

Thus the British Government has fulfilled to the letter its engagement to carry an electric wire from India to the confines of the Turkish possessions in Asia Minor; but how has the Turkish Government done its part? We regret to be obliged to state, that though furnished by us with every possible assistance, both in *personnel* and *materiel*, yet from total loss of that energy which rendered them once the scourge of the world, and by inability to control the wild tribes—nominally their subjects, but really independent—through whose country they were to have carried the land wires, they have left us in a position very little better, as regards communication with Europe, than we were before the Persian Gulf cable had been laid. At least for some months to come we cannot hope to send messages to England in less than six or eight days, or to receive them in less than four or five, although a message can be sent from Kurrachee to Fao, and the answer received, in half an hour.

The points on the projected Turkish lines between which no telegraph has been erected at all as yet, are Medina, near the junction of the Tigris and Euphrates, and Diwaniyeh, about 100 miles from Bagdad. Medina is over 100 miles from the end of our submarine cable at Fao, so that of the 380 miles from Fao to Bagdad upwards of 150 remain to be completed. Nor can any hope be entertained that this will be done before the end of the year, as the country is in a state of anarchy, and the Arabs refuse to allow the work to be carried on, while the jealousy of the Turkish Government will not allow it to avail itself of British intervention, though, judging from the temper of the Arabs towards us, and especially towards Colonel Kemball, the British resident at Bagdad, there is the strongest reason to believe that it might be successfully employed for the restoration of order. Indeed, there can be little doubt that the Turkish authorities are aware how speedily, if permitted, we could prevail upon the Arabs to return to their allegiance; but a natural, though blameable, pride leads them to allow the revolt to continue rather than acknowledge their own weakness by accepting assistance.

However, the political state of the country is not the only bar which at present exists to the completion of this part of the telegraphic route to Europe. The work has been so long delayed on that account, that the unhealthy season has set in, and till October or November Europeans will be unable to remain in the neighbourhood of the marshes which lie about the region where it has to be carried on. Till, then, this part of the line has been completed, some means other than electricity must be employed to convey messages across the space between Medina and Diwaniyeh; and

an attempt is being made to do so by *cossids*, or mounted messengers, selected from the inhabitants of the districts through which they have to travel; but it is doubtful whether the country is not too unsettled even for this plan to work successfully; so that the only means which can be confidently relied upon are the river steamers which run between Bagdad and Bussorah, and of which there are now five—two belonging to the Bombay Government, two to the Turkish Government, and one to an English mercantile house (Messrs. Lynch & Co.) The boats can perform the journey down stream in from two and a half to three days, from five to six days being occupied in returning to Bagdad. But unfortunately, even when a message has reached Bagdad, it has not got over all the difficulties which may interrupt its progress; for the Turkish lines between that city and Constantinople are so wretchedly constructed and looked after, that breaks-down are almost as frequent as between Bombay and Kurrachee, while, even if the line happens to be in good order, there is no certainty that English messages will be transmitted in an intelligible language, for the Turks insist on having all messages sent through in Turkish, so that frequently, when re-translated, they bear as much resemblance to their originals as do proverbs in Captain Cuttle's mouth to theirs. So great, indeed, are these evils—the faulty construction of the Turkish lines, and the faulty transmission of messages along them—that when at Bagdad Colonel Stewart determined, after consultation with Colonel Kemball, that a British officer ought to inspect the whole arrangements between Bagdad and Constantinople, and having obtained the permission of the Turkish Government for its being done, he requested Lieutenant-Colonel Frederic Goldsmid to undertake the journey, accompanied by a staff of electricians and others, to assist him in his inquiries with their technical information. We believe that Colonel Goldsmid will remain at Constantinople till Colonel Stewart himself arrives there viâ Aden and Alexandria, when, guided by the information collected by Colonel Goldsmid, the British Ambassador will endeavour to urge upon the Turks all the improvements necessary in their telegraphic system, and will also, we trust, secure the introduction of English signallers for English messages.

We referred above to the disgraceful failures in the line of telegraph between Bombay and Kurrachee, an efficient condition of which can scarcely be counted upon for two consecutive months. At this very moment it is broken down, and messages from this to Kurrachee have actually to go round by Lahore. We are assured by those well qualified to offer an opinion, that no insuperable, or even very unusual, difficulties are the cause of this; but that it results almost solely from the obstinacy of those who insist in refusing to apply to Indian telegraphs the improvements which are being daily made in this almost infant branch of practical science. What would be thought of the railway company which should insist on attempting to carry on the traffic of their lines with engines made after the pattern of Robert Stephenson's "Experiment"? Those who are responsible for the faulty condition of the line to which we are referring may thank their stars that the Turks are as dilatory and careless to improve as themselves, for if the Turkish line had been opened, and messages had come, as they might have done, from England to Kurrachee in forty-eight hours, and had then been delayed five days between Kurrachee and Bombay—a distance of less than 500 miles—the storm of indignation would have been too great even for their callous indifference. They have now a respite of nearly six months; let them see that they employ it well. We may be compelled to put up with inefficiency in lines passing through foreign states, but we must have the highest possible efficiency in those under our own immediate control. If one man cannot do what is required, another can, as we see in the masterly manner in which the Persian Gulf submarine line has been completed.

But to return to the difficulties of completing the communication between the Persian Gulf and Bagdad, we are glad to say that we shall very shortly be able to avail ourselves of another route than that through Mesopotamia. Thanks to the untiring energy of Captain Champain, R.E. (a kindred spirit and an intimate friend of Colonel Stewart), and to the labours of Colonel Lewis Pelly, the British Resident at Bushire (who is now in Bombay), the Persian lines are nearly completed, and may be expected to be in working order within three months. Messages will then leave the submarine cable at Bushire, pass along the Persian line to Teheran, and thence to Bagdad; or if the line between Teheran and Tabreez is open first, they will enter Europe by that route.

Thus we may count with certainty on rapid communication between the east and west within three months; and we have the satisfaction of knowing that if other nations who are interested had worked as hard as we—if they had possessed Stewarts and Brights, Champains and Webbs—it would have existed ere this. We hope a discerning public will not allow those who have worked so hard and so well on its behalf, to go unrewarded with the thanks and credit to which they are so justly entitled, because circumstances entirely beyond their control prevent for a time the full benefit of their labours being experienced. The *éclat* with which the opening of the line might have been anticipated to take place is, of course, altogether wanting now, but the solid advantages of Colonel Stewart's labours can be doubted by none, and will grow and increase day by day. As a soldier, if he be called to command, he can never achieve anything for which he will more heartily deserve the thanks of Government and the public, than for the leading part he has taken in the great work of laying the Indo-European telegraph cable.—*The Times of India, May* 16.

THE AMERICAN COMMISSIONER ON THE POLICY OF PATENTS.

(Continued from page 285.)

ANOTHER class of inventions benefit the community, not by diminishing the price of goods for which there is already a public demand, as in the case just cited, but by producing and introducing labour-saving contrivances which the people must be taught to appreciate and use. Such are the inventions of labour-saving agricultural implements, which within the last twenty years have aided so materially in developing the resources of the country. The inventors and manufacturers of these machines, although prompted by a selfish, but at the same time intelligent interest, have been more truly and effectually the instructors of the people than all the agricultural colleges in the land. The protection which the patent affords is not only the cause in a majority of instances of an invention being made, but it is positively the cause why it is introduced and received. Losing sight of this practical truth, the Government of Canada prohibited Americans from obtaining patents in that province, mainly for the reason that they could obtain the benefit of our inventions without paying for them. The result has been that, as it was for no one's interest to instruct the Canadians in the new mechanical arts of agriculture, they have plodded along with the old tools, and have been benefited by none of the inventions which have stimulated the agriculture of the neighbouring States.

In this country, in consequence of the protection which the patent laws afford, the inventors have found a ready sale of good inventions to capitalists and manufacturers who possessed the capital required to put the inventions into practical form. It is to those manufacturers that the introduction of the seeding, harvesting, and mowing machines, threshers, cultivators, &c., is immediately due. With a single eye to commercial results, they sent their agents through the rich agricultural districts, principally of the west, to exhibit the new machines and teach their operation. The agents convinced the farmers that the saving in the gathering of one year's crop would reimburse the cost of the machines, and readily made sales upon the understanding that the notes given in payment for the purchase should be paid out of the proceeds of the crop gathered by their use. The unparalleled rapidity with which the labour-saving machinery of the farm has been introduced throughout the west, in contrast with the proverbial slowness of the farmers of former times in adopting new improvements, must be attributed to the system I have just described.

We can hardly over-estimate the benefit which the country has derived from these inventions, whose origin and introduction can be so clearly traced to the stimulus and protection by patents.

It is stated by Mr. Kennedy in the census report for 1860 that a threshing machine in Ohio, worked by three men, with some assistance from the farm hands, did the work of 70 flails; and that 30 steam threshers only were required to prepare for market the wheat crop of two counties in Ohio, which would have required the labour of 40,000 men. It is estimated that a single reaping machine effects the saving of the labour of five men. With a good reaping machine ten men will cut, bind, and stack and house from ten to twelve acres per day, or 200 acres in a single season—a task which would have required without machines the labour of fifteen men for its accomplishment. From reliable returns it is shown that 40,000 reapers have been manufactured and sold within the last year; and it is estimated by the manufacturers that over 90,000 will be required to meet the demand for the next year. They will effect the saving of the labour of 450,000 men. The quantity of wheat grown in all the States and territories in the year 1849 was 100,485,944 bushels. The quantity grown in 1859 was 171,183,381 bushels—an increase of nearly 70 per cent., or about double the increase of population in the same period.

It has been remarked that just before the commencement of the present war there was throughout the whole north, from no apparent cause, but, as it seemed, by an inspiration of Providence, a revival of a military enthusiasm which had slumbered for years. Without any concert, military organizations sprang up in every northern State, and at the sound of the first gun at Sumter, regiments, fully armed and equipped, were ready to rush to the capital. It is no less remarkable that the inventive genius of the nation within the last few years had taken a direction which has prepared the nation for the enormous demands upon her men and treasures. In consequence of this influence, the productive energy of the country has not been slackened, yet a million of men could be spared to fight our battles. And thus to each call from our great leader the people have been able to respond—

> "We are coming, Father Abraham,
> Six hundred thousand more!"

The war, instead of checking, has stimulated our creative power in every branch of industry.

Within the last year there have been patented 240 inventions in implements of war, but during that period there have been patented 490 inventions of agricultural implements. And although the happy time foretold by prophecy has not yet come, when the nation shall know war no more, the sword and the spear still yield to the ploughshare and pruning-hook, and the arts of peace hold supremacy over the arts of war.

The next question which I propose to discuss is the comparison of our

own system of patents with those of the great industrial nations. Our patent system is founded mainly upon the statute of 1836, framed under the advice of the most experienced lawyers of the period, but carried through by the energy and wisdom of a distinguished senator of Maine, Mr. Ruggles, who deserves the grateful acknowledgments of the country for securing the passage of an act which has proved one of the most beneficial in our legislative history. The characteristic feature of our patent policy is the system of examination as to the novelty of inventions conducted by the Commissioner of Patents through an examining corps, selected for their special accomplishment in the arts which it is their duty to examine. No system of examination like our own exists in Europe, except to a very limited extent. I have before me a synopsis of the patent laws of nearly all the countries in Europe. In Great Britain, France, Austria, Belgium, Spain, the Roman States, Sardinia, and the Sicilies and Saxony, there is no examination as to novelty. In Prussia, Russia, the Netherlands, Hanover, and Bavaria there is an examination by learned societies and commercial boards, instituted mainly for other purposes, but the whole number of patents granted in the last-named countries in 1858 was only 173; while in the first-named countries in the same year there were issued 10,297 patents. So that, considering the number of patents issued, our own peculiar system stands comparatively alone among those of all civilized nations. But before proceeding to a consideration of our own system, I will state the principal features of the present patent law in Great Britain, which are of more interest to American inventors than those of any other country. These are well stated in a sensible speech made by Sir Hugh Cairns in the House of Commons in May, 1862, whose language I shall use with some abbreviations. The act of 1852 completely altered the system of patents which had previously prevailed. In the first place, before 1852 there was no means by which a person, who supposed he had arrived at an invention, could obtain temporary protection during the time that he was endeavouring to perfect it by experiments; and while making the experiments, there was the danger of their publication, and thus preventing the obtaining of any patent at all. In 1852 the legislature provided that, upon an inventor lodging a description of his invention, he should have a provisional protection for six months. The second change was in reference to the publication of specifications. Up to 1852 the specifications were kept in writing in certain very obscure offices in London, and were virtually inaccessible to the manufacturers of the kingdom. The Act of 1852 provided that all specifications should be printed and sold at a moderate price. A mode of payment entirely novel was originated in 1852. An inventor suing for a patent pays £5 on lodging the provisional specification, and he pays nothing more for six months; at the end of six months, if he wishes to obtain a grant, he pays a sum of £20, and he pays nothing more for three years; during the three years he is able to consider whether the patent is worth any further outlay, and if so, a payment of £50 carries him on for seven years; during the seven years he has the opportunity of considering again whether the patent is worth any further outlay; and if at the end of that time he wishes to be further protected for fourteen years, he has to make a final payment of £100; the total payment is, therefore, £175. And it is held that the payment being made by instalments, and increasing only as the profits of the invention might be supposed to increase, it is hardly irksome in any degree to the patentee—a view, I may remark, by no means supported by others in England who have discussed this feature of the present law. The honourable member inquires what had been the consequence of the change of the law in the increase of the number of patents, and the results of his inquiries remarkably illustrate the benefits of a liberal legislation. Twenty years before the Act was passed, in 1833, the number of patents was 108. In 1851, the year before the alteration of the laws, the number of patents was 455. In 1852-53, after the new Act came into operation, the number of provisional protections for inventions was 3,260, out of which 2,050 patents were actually sealed.

These changes, although far from realizing the demands of the inventors of Great Britain, were vast improvements upon the laws existing previous to that time. Under the old law the process of an application for a patent, as stated in the London *Quarterly Review*, was required to pass through no less than nine stages and seven distinct offices situated in different places. Indeed, the object of sending the application through one of these offices was openly stated in the statute of Henry VIII., c. 11, "that the clerks should not by any manner of means be defeated of any part or portion of their fees." If the letters patent were required to extend to Scotland and Ireland, as well as to England, all the proceedings had to be gone through separately in each of the three cases. Thus the same patent may be said to have run the gauntlet of twenty-one offices. So heavy were the fees—applied not to the expenses of the patent offices, but mainly to swell the emoluments of the Lord Chancellor, Attorney-General, and other high officers—that the cost of a patent for the United Kingdom could not be estimated at less than £350, while the attendant expenses of preparing the specification, &c., often doubled the amount. It cannot be wondered that Mr. Dickens's poor inventor was forced to complain: "Is it reasonable to make a man feel as if, in inventing an ingenious improvement meant to do good, he has done something wrong? How else can a man feel when he is met with such difficulties at every turn? All inventors taking out a patent *must feel so*. And look at the expense. How hard on me, and how hard on the country, if there is any merit in me (and my invention is took up now, I am thankful to say, and doing well), to put me to all that expense before I can move a finger."

Under the present as well as the old laws, the only investigation which alleged inventions undergo before patents are granted is conducted by the law officers of the Crown. They never inquire into the novelty of the invention. All that they do is to see that the alleged inventor describes in a clear and intelligible manner what he claims as his invention, so that he may not add to or take from it.

(To be continued.)

CORRESPONDENCE.

JOINTS IN SUBMARINE CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your last week's number you make reference to some testings which I have had conducted on my submarine telegraph cable under a pressure of 6,000 lbs. (not 6,700) per square inch, and which, as you truly state, gave the most satisfactory results. Permit me, however, to draw your attention to the fact that the core was not "newly-designed," but a length measuring 1,686 yards, of a similar construction to some lengths tested by Mr. Owen Rowland, in November, 1861. It was taken indiscriminately from twenty miles, and may be considered, both in its insulation and construction, as an ordinary illustration of my manufacture. It contained joints. I have joints that were made years ago, some of which have been kept in salt water, others in fresh water, and others exposed to the action of the atmosphere: they all remain perfect.

Many distinguished engineers, and professors of natural philosophy, have witnessed the manufacture of considerable lengths of my cable, and the making of joints. They have satisfied themselves that by my process the joints, *mechanically considered*, cease to exist both in the india-rubber and in the vulcanized exterior, and also that no defect or change can be discovered, electrically or otherwise, in lengths (with and without joints) which have been made upwards of four years. The joints, in fact, test as perfectly as any other part of the insulation, and are as durable. Reports have been obtained from the highest authorities in applied electrical science that two of my cables will convey as many messages across the Atlantic, or any other long length, as three cables of similar size insulated with gutta-percha.—I am, sir, your obedient servant, WILLIAM HOOPER.

7, Pall Mall East, S.W., June 21st, 1864.

[We are glad to learn that Mr. Hooper has succeeded in overcoming an acknowledged mechanical difficulty. The particulars with which we are favoured above, however, leave us completely uninformed as to whether the rubber joints were subjected to the action of a current of electricity for any length of time.—ED. T. J.]

TELEGRAPHIC NEWS.

THE GREAT EASTERN.—This vessel has lately taken on board 3,000 tons of coal, and will shortly leave Liverpool for Sheerness or Deptford, where she will be fitted with water tanks to receive the Atlantic telegraph cable now in course of construction at the works of Messrs. Glass, Elliot, & Co.

RUSSO-PERSIAN TELEGRAPHS.—It appears that, by virtue of a convention recently entered into between Russia and Persia, electric communication is now being continuously carried on between the two countries, by the way of Tiflis.

TELEGRAPHY IN VANCOUVER'S ISLAND.—We (*Weekly British Colonist*) learn from Mr. Strong, a gentleman connected with the State Telegraph Company, that Mr. Superintendent Haynes was about to explore the country between Portland and Puget Sound, with a view to ascertaining the best route for the wires. The work is to be commenced without delay.

MALTA AND ALEXANDRIA TELEGRAPH.—We are enabled to see the progress and commercial value of this important line of communication by a small Parliamentary paper just issued on the motion of Mr. Crawford, M.P. for the City of London. Messrs. Glass, Elliot, & Co., the contractors, entered upon the lease of the line in November, 1861, and up to the end of that year they sent 27 Government messages, and various other local and through telegrams to the number of 1,615, producing a revenue of £8,142 15s. In 1862 business went on at a thriving pace; Government sent 806 official messages, and the public upwards of 19,000. The income was thus raised to £38,380 7s. The year 1863 brought a total of 28,067 telegrams, producing a revenue of £52,142.

THE TELEGRAPH BETWEEN GLASGOW AND ROSENEATH, &c.—Messrs. Reid Brothers are at present engaged in erecting a line of telegraph from Glasgow to the Mull of Cantyne (this important line will include the Northern Light Commissioners' stations of Cantyne, Pladda, and Cumbrae lighthouses) for the receipt and transmission of shipping intelligence along this dangerous coast, with a telegraph station at Lamlash Harbour, where the steam tugs are in readiness to render assistance to vessels when required. This line will open up telegraphic communication between Glasgow, Campbelton, Rothsay, Greenock, Inverary, and Ardrishaig, and between Glasgow and the watering-places on the north bank of the Clyde, such as Dunvon, Mellan, Shone, Kilcreggan, Roseneath, &c.

PROGRESS OF TELEGRAPHY.—The large and extensive manufactory of Messrs. De la Rue, in Bunhill-row, has been fitted up, on the plan of Mr. C. V. Walker by Reid Brothers, of Wharf-road, City-road, with a perfect system of electrical apparatus for connecting the various rooms in the establishment. There is in the arrangement fifty-nine bells, thirty-eight ringing keys, and several galvanometers. The object to be obtained is, that from the central office the manager or foreman of each separate room can be summoned at pleasure to receive instructions from the principal. The bells in each room also give notice to commence, meal hours, and leaving off time. The whole is in the most efficient and perfect working order, and saves a vast amount of time and labour. The clock is regulated by the time from the Greenwich Observatory, and is under the supervision of C. V. Walker, Esq.

BRITISH AND IRISH MAGNETIC TELEGRAPH COMPANY.—The annual fête of the London employés belonging to the above company took place on Saturday last, June the 18th, and proved to be a most attractive réunion. The party (consisting of over forty, including wives and sweethearts) proceeded by train to Sydenham to witness the handicap announced in our columns of February the 20th. After a most exciting race between eight competitors, the final contest was left to Messrs. Wright, Manning, Wild, and Ross; the former being declared the winner by a yard, the others coming in in the order named. The severe struggle at the finish may be judged when we say that barely four yards separated the four above-named gentlemen. The pleasure-seekers then adjourned to the far-famed Anerley Gardens, where, a sumptuous repast being provided by Mr. Hinton, all refreshed themselves to their heart's content, and prepared to join in the amusements provided at this rural spot, viz., boating, swinging, the intricacies of the maze, &c.; but when the splendid band struck up a polka a rush was instantly made to the platform and the light fantastic toes quickly went to work. After a few dances, another move was made to a room specially provided for the occasion, where, Mr. J. C. Newbury being called to the chair, the usual loyal toasts were given, and the prize, consisting of a handsome electro-silver cup, presented by the clerks in charge, was handed to the winner of the handicap, whose health was drank in a bumper of champagne, amid uproarious cheers for "auld Scotland." The other toasts which followed were "Success to the Magnetic Company," coupled with the name of Mr. Edward B. Bright; "The Visitors;" "The Ladies;" and "The Chairman," in whose praise a capital poetic effusion by Mr. J. Brown was read by Mr. J. W. Manning, vice-chairman. An extempore "Song of Events" in connection with the Central Station during 1863-4, was given by Mr. C. Desmond, a retired telegraphist, and was cheered to the echo at several points. A railway-crushing return to town brought this very pleasant Magnetic Derby-day to a successful conclusion, every one having thoroughly enjoyed themselves. In conclusion we may add that the handicap prize is a *Challenge Cup*, the present winner having to hold it against all comers up to December 31st; we shall therefore have to record several contests for this beautiful trophy.

SILVER'S INDIA-RUBBER WORKS AND TELEGRAPH CABLE COMPANY, LIMITED.—Some very important alterations have been proposed in the above company, as will be seen on reference to our advertising columns. The following circular has been sent to the shareholders, with notice that a series of resolutions will be submitted at an Extraordinary General Meeting to be held at the London Tavern, Bishopsgate-street, E.C., on Thursday, the 30th June:—"38, Broad-street-buildings, London, 20th June, 1864.—Dear Sir,—In explanation of the accompanying notice it may be desirable to remind you that one of the main objects of this company was to add to the established manufacture of india-rubber, and the opening one of balata, that of gutta-percha; and I am now desired by the directors to acquaint you that they have succeeded in forming a most desirable connexion for that purpose. Having learned that a new company, strongly backed, was in process of formation for carrying on the manufacture of gutta-percha on a large scale, your directors placed themselves in communication with the gentlemen with whom the project had originated, and having satisfied them of the ample accommodation that would be furnished at Silvertown for the necessary works, they have entered into an arrangement for an amalgamation of the two undertakings. You are no doubt aware that the india-rubber and gutta-percha manufactures of this country have hitherto been to a great extent excluded from France and Belgium, where protective duties have counter-balanced the inferiority of quality which results from inefficient management, and you will readily recognize the enhanced value that would attach to the foreign factories if their cheap labour were brought under the control of the skill and experience gained in English works. The inquiries instituted by your directors have resulted in a contract for the purchase of three of the most important of the French and Belgian factories, whose valuable patents render the acquisition of these works indispensable to the carrying out of the objects of the company with reference to the continental business. In view of the extent of operations at home and abroad now contemplated by the company, it was considered requisite to double the nominal capital, at the same time adhering to the former policy of issuing one-half only in the first instance; and this half it is proposed to dispose of as follows:—The promoters of the New Gutta-Percha Company, who, with their friends, contemplated subscribing a large capital for their original object, have now the option of taking a considerable proportion of the £250,000 stock which it is now proposed to issue, and a similar option is given to French subscribers on behalf of the continental purchases, which involve an outlay of some £60,000. Any balance will be offered, pro râta, to the existing shareholders. The above arrangements include the introduction of John Harvey, Esq., and George Henderson, Esq., of 7, Mincing-lane, as directors of the company, and of two gentlemen of similar standing in France. The directors have also pleasure in announcing that they have secured the services of Messrs. Charles and Walter Hancock in the management of the balata and gutta-percha department of the manufacture.—I am, sir, yours obediently, JUSTINIAN PELLY, Secretary."

MISCELLANEA.

REPETITION OF WORDS.—A number of Pitman's *Reporter* calculates the proportionate use of words in 30,000 to be as follows:—

The	1727	is	366	be	278	have	193
and	1221	it	353	as	231	which	193
of	1153	his	288	he	228	all	184
to	864	with	278	but	202	from	184
in	581	for	270	are	198	your	177
that	416	you	265	not	195	or	164

This, we, they, may, will, our, him, on, their, at, more, what, me, them, who, &c., taper down from 150 to 100.

JOULE'S NEW SENSITIVE THERMOMETER.—At a recent meeting of the Manchester Philosophical Society, Dr. Joule exhibited an exquisitely sensitive air thermometer, capable of being affected by the $\frac{1}{1000}$ of a centigrade degree of heat. The construction is thus described:—"A glass vessel in the shape of a tube, two feet long by four inches in diameter, is divided longitudinally by a blackened pasteboard diaphragm, leaving spaces at the top and bottom, each a little over an inch. In the top space, a piece of magnetized sewing needle, furnished with a glass index, is suspended by a single filament of silk. It is evident that the arrangement is similar to that of a bratticed coal-pit shaft, and that the slightest excess of temperature on one side over that on the other must occasion a circulation of air, which will ascend on the heated side, and, after passing across the fine glass index, descend on the other side. It is also evident that the sensibility of the instrument may be increased to any required extent, by diminishing the directive force of the magnetic needle. I purpose to make several improvements in my present instrument; but in its present condition, the heat radiated by a small pan, containing a pint of water heated 30°, is quite perceptible at a distance of three yards. A further proof of the extreme sensibility of the instrument is obtained from the fact that it is able to detect the heat radiated by the moon. A beam of moonlight was admitted through a slit in the shutter. As the moon (nearly full) travelled from left to right, the beam passed gradually across the instrument, causing the index to be deflected several degrees, first to the left and then to the right. The effect showed, according to a very rough estimate, that the air in the instrument must have been heated by the moon's rays a few ten-thousandths of a degree, or by a quantity, no doubt the equivalent of the light absorbed by the blackened surface, on which the rays fell."

THE MOST RECENT SPECTRUM DISCOVERIES.—The following is an abstract of a lecture on the above subject, delivered before the Royal Institution, by Professor Miller, F.R.S.:—"Among the rays emitted by the sun, there were three kinds interesting as endowed with special action—those which conveyed heat, light, and chemical action. With heat he should have but little to do on this occasion; about light he had something to say, but he was now principally concerned with the rays which manifested themselves by producing chemical action. It was well known that transparent substances did not transmit all these rays with equal facility. Glass was only imperfectly transparent to the chemically active rays, which were found in the most refrangible rays of the spectrum, heat rays being in the least refrangible portion, and light occupying the middle place. It had been found that rock-crystal was one of the few substances which perfectly transmitted those highly refrangible rays which glass absorbed. The professor then showed that some kinds of light were without chemical action, the light from a mixed air-gas flame possessing scarcely any, while that from an ordinary gas-flame did possess a little. The oxy-hydrogen flame, while attended with intense heat, was endowed with very little chemical action. A prepared collodion plate exposed to this light for twenty seconds gave a very faint picture. But when the flame was thrown on lime, although the temperature was lower, the light had sufficient chemical activity to produce a strong picture on a similarly prepared plate, exposed for the same time. In the case of the chemically acting ray, the intensity, number, and position of the lines on the spectrum had been found to vary with the source of light. The most remarkable illustration of this was the different spectra produced by the electric spark of an induction coil between poles of different metals, and projected upon a photographic plate. The spectrum produced by the spark from silver poles, for example, was found to be three times the length of the whole of the solar spectrum transmitted by quartz. In order to obtain views of this invisible spectrum, it was necessary to transmit the rays through a medium more transparent to chemical rays than glass, which, it had been said, was opaque to the higher rays of this kind, and various experiments had been made to ascertain what substance allowed them to pass most freely."

Magnesium.—In the *Proceedings of the Royal Society*, No. 63, are reported some researches of Dr. T. Phipson on this metal, now becoming so interesting in relation to its illuminating properties. He states that magnesium is capable of reducing silicic acid at a high temperature, which the alkaline metals, sodium, and potassium, cannot do, as they volatilize before the crucible attains the proper heat. It decomposes carbonic acid from dry carbonate of soda, and it precipitates nearly all the metals from their neutral solutions. Unlike zinc, it will not unite with mercury at the ordinary temperature of the air. With platinum, according to M. Sonstadt, it forms a fusible alloy; and it is probable that an alloy of copper and magnesium would differ from brass not only in lightness, but by being able to decompose water at the ordinary temperature with more or less rapidity. This last effect is also produced by combination of sodium and potassium, which are very malleable alloys. Magnesium will be found a useful metal whenever tenacity and lightness are required, and where tarnish is of no consequence. It is especially valuable in the laboratory for effecting decomposition, which sodium and potassium cannot effect on account of their greater volatility.

The Voltaic Battery.—Faraday has shown that in a voltaic battery the chemical action in each cell is exactly proportional to the quantity of electricity flowing through it. Now, every part of a circuit (including, of course, the battery), whatever be its form, nature, or resistance, is traversed in a given time by equal quantities of electricity; just as in a river the same quantity of water passes any given part of the channel each minute, whether the stream be narrow or broad, shallow or deep, because each part is supplied by that which precedes it, and in the like manner supplies the succeeding length. From this cause the chemical action in each cell is equal where there is no waste from local action (36), an equal quantity of sulphate of copper is decomposed, and an equal weight of zinc dissolved, in each cell in the series. That is to say, if in one cell of a series of 100 one ounce of sulphate of copper be decomposed, exactly one ounce (neither more nor less) will be decomposed in each of the other 99 (it matters not whether these cells are active, as in a battery, or not); therefore, to circulate a given quantity of electricity, an equal amount of sulphate of copper is consumed in every cell used to circulate it. For every 32 lbs. of metallic zinc dissolved, 124 lbs. of sulphate of copper will be decomposed, and about 32 lbs. of metallic copper deposited upon the copper plates.—*Mr. R. S. Culley's Handbook.*

The Divisibility of Matter.—What the real size of ultimate particles may be we have no means of determining, although, as will be seen hereafter, there are strong grounds for believing that the divisibility of matter, extreme as it is, has its assigned and definite limits. Experience, however, shows that whatever be the form of matter selected for our experiments, that divisibility may be manifested to an extent which transcends our powers of conception. The divisibility of gold is often given in illustration of this point. In the ordinary process of making gold-leaf, a single grain of gold is hammered out until it covers a square space seven inches in the side. Each square inch of this may be cut into 100 strips, and each strip into 100 pieces, each of which is distinctly visible to the unaided eye. A single grain of gold may thus, by mechanical means, be subdivided into $49 \times 100 \times 100 = 490{,}000$ visible pieces. But this is not all; if attached to a piece of glass, this gold-leaf may be subdivided still further; 10,000 parallel lines may be ruled in the space of one single inch, so that a square inch of gold-leaf, weighing $\frac{1}{49}$th of a grain, may be cut into 10,000 times 10,000 or 100,000,000 pieces, or an entire grain into 4,900,000,000 fragments—each of which is visible by means of the microscope. Yet we are quite sure that we have not even approached the possible limits of subdivision, because, in coating silver wire, the covering of gold is far thinner than the gold-leaf originally attached to it, since in drawing down the gilt wire the gold continues to become thinner and thinner each time, in proportion as the silver wire itself is reduced in thickness.—*Miller.*

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1496. T. J. Hughes, an improved composition to be used for coating and insulating.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1340. T. W. Smith, improvements in "tell-tales," or apparatus for registering or indicating the hour at which any desired apartment or spot has been visited.

NOTICES TO PROCEED.

1345. P. Deeley, a new or improved machine for testing the strength of wire.

PATENTS SEALED.

3290. H. Caunter, improvements in the manufacture of lubricating matter or composition.

PATENTS ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1539. F. Potts, certain improvements in the manufacture of metallic posts for supporting telegraph wires, and which said improvements are also applicable for other purposes.—15th June, 1861.

1580. J. F. Williams, improvements in compounds of india-rubber and gutta-percha with other substances.—19th June, 1861.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.
Good re-boiled	1/6 to 1/8 ,,

India Rubber.

Para, first quality	1/10 to 1/11 ,,
second ,, ...	1/7 to 1/8 ,,
third Negro-head	1/2 to 1/3 ,,
Java and Penang	1/4 to 1/5 ,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	99 to 102	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{1}{4}$ to $\frac{3}{4}$ dis.	—

TO CORRESPONDENTS.

Arrangements have been made with contributors in all parts of the world, whereby we shall be able to lay before our readers the most reliable information concerning telegraphy on the continent and in America.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

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THE

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A

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TO OUR READERS.

When the *Telegraphic Journal* made its *début*, we stated our objects and solicited support. Now, on the occasion of publishing the last number of the second volume, we purpose addressing a few observations to our readers on the present aspect of electrical science and telegraphic art, and to show that our efforts to establish an organ for the diffusion of knowledge on these subjects have not met with the countenance and patronage we had anticipated.

It is but a short time since we directed attention to a Report on Electrical Standards, prepared under the auspices of the British Association for the Advancement of Science, by a committee of the foremost men engaged in scientific pursuits. We freely criticised this document in a recent issue, and, in dismissing all thought of arriving at any satisfactory conclusions from a further perusal of the anomalies of the "Thirteen," whose prestige led us to expect better things from them, we are constrained to confess that, though avowedly defining and explaining standards for electrical measurements in a very elaborate manner, this addition to the records of the British Association, renders "confusion worse confounded." The annals of literature have not been considerably enriched of late by contributions of electrical lore, yet great advances have been made in the application of the subtle fluid to useful purposes. Among the most conspicuous improvements in electrical apparatus is Mr. J. B. Thompson's induction machine, an instrument whereby currents of electricity moving in one direction, of any required electro-motive force, may be obtained from a battery of small electro-motive power. The particular uses of this machine are for telegraphing, submarine cable testing, and electro-plating; it is also invaluable for the production of the electric light, and for coating the entire iron exterior of ships with copper. Many other ingenious adaptations of electricity have come under our notice, but we cannot proceed to enumerate them in this place.

The rapid extension of the business of electric telegraphing in all parts of the world is the best evidence of its utility and importance. The idea of Puck is in course of realization. Not only do we join house to house, and town to town, but from island to continent, from continent to far distant empires, through deep seas and unfathomed oceans do we stretch our cables, in order to facilitate the means of speedy communication. The much vexed question as to the practicability of laying and then signalling through long lengths of insulated wire submerged in great depths has been definitely settled. The Persian Gulf Telegraph is no longer an experiment, but may be pronounced *un fait accompli*. This great triumph leads us to hope that success will attend the renewed attempt which will be made in the spring of the ensuing year to permanently unite England with America. The work of manufacturing the cable for this purpose is progressing rapidly, and there is every prospect of the Atlantic Telegraph Company being able to restore the public confidence in submarine telegraphy, so terribly shaken by the disaster of 1858. Of the projects in contemplation, perhaps the boldest in conception and design is that for linking India, China, and Australia by a chain of electric telegraphs. Not only does the eminent engineer, Sir Charles Bright, certify to the feasibility of this scheme, but he expresses his conviction that the necessary works for effecting this object may be completed in a few years.

Having thus briefly alluded to the condition of electrical science, and the state of telegraphic art, we desire to communicate to our subscribers a determination to which we have been impelled by a combination of circumstances which it would be unwise to ignore. We acknowledge with thankfulness the aid rendered by Admiral FitzRoy, Mr. W. H. Preece, Mr. R. S. Culley, and other gentlemen (whose services are deserving of special recognition, but whose names we are not at liberty to proclaim), in supplying information, and otherwise contributing to the usefulness of the *Telegraphic Journal;* but, inexplicable as it may appear, it is nevertheless true, that we have never received the countenance of the body of practical telegraphers. It has been our duty to chronicle from time to time the researches of investigators, to describe new inventions, to keep a watchful guard over the interests of shareholders in telegraph companies, and to promote the welfare of the persons employed in telegraph offices. As to the manner in which we have performed these trusts, let our readers testify. At a great pecuniary sacrifice we have sustained the *Telegraphic Journal* now twelve months, striving, with the resources at command, to make it worthy the perusal of the man of science, and interesting to the humble telegraph operator. The conscientiousness of having performed a public service will enable us to bear the loss already incurred by our venture; but we cannot continue to occupy the position of "guide, philosopher, and friend," to telegraphers, under the conditions with which the office is invested. This number will therefore conclude the second volume, and be the last of the *Telegraphic Journal.*

4 & 5, Suffolk Lane, E.C.,
24th December, 1864.

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THE TELEGRAPHIC JOURNAL.

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RAILWAY ACCIDENTS.

THE inquest at Egham has closed. The verdict has been given. The driver and his fireman have been convicted of manslaughter, and the London and South-Western Railway Company have been severely condemned for their mismanagement.

No one for a moment will hesitate to coincide with the justness of this verdict, at least as regards the engine-driver. It is impossible to overrate the responsibility that rests upon this class of men: they hold the lives of thousands in their hands. The slightest neglect, the least carelessness drags hundreds into imminent danger. They have signals to guide them, firemen to assist them, guards to check them, and yet cases occur where wild heedlessness and gross inattention leads to frightful suffering and lamentable woe. Where dependence is placed upon human agency, there must be human error. The arrangements of a railway company may be perfect; the signals may be up; danger may be visible; yet a thoughtless driver may dash his train into the midst of peril. Such temerity can only be punished by severity. Take this Egham accident. On a busy racing day, when the line was blocked with trains crammed with pleasure-seeking excursionists, a stupid engineman drives his precious train, at express speed, over a line which he knows only a few minutes previously has been traversed by another heavy burden. He suddenly is warned of danger a-head. The upright semaphore arm, the red flags, the wild gesticulations of a frantic station-master bid him stop, but he has lost all control of his train, he dashes on, and death and frightful sufferings result. The verdict is therefore just as regards this man: he will be tried for manslaughter, and let us hope that he will be punished accordingly. But are the jury right in condemning the arrangements of the railway company? The driver was told not to travel at a greater speed than thirty miles an hour—he went fifty. He was told when he saw a danger-signal a-head to stop, and proceed gently until he approached the danger—he neglected the signals. Are the railway company responsible for this? The jury say they ought to have had a turntable at Ascot, but would a turntable have prevented the accident? They say there was no communication between the guard and the driver, but would such communication have in any way mitigated the effects of the accident? Not in any way. Communication between guard and driver is found practically useless, and in this particular instance would have been of no avail.

But the jury condemn the company "for not using telegraphic communication from station to station." Here we must pause. Would the proper use of the telegraph on this line have obviated this distressing affair? We unhesitatingly answer *yes*. There are two systems upon which lines of railway are worked: the one is termed the *time*, and the other the *block* system. The *time* system presumes that trains are always to be maintained a certain distance apart by an interval of time. Thus one train is not allowed to pass a station until a previous train has disappeared at least five minutes before it. The *block* system provides that trains shall always be maintained apart by a certain *space* of line. Thus two trains are never allowed to come within two miles of each other. The line is divided into certain spaces of about two miles in length, and no two trains are allowed to be on the same space at the same time. The South-Western Company work their lines on the time system, with what result is shown in this accident. Had they adopted the block system could the accident have happened? Undoubtedly not; for the second train could not have left Virginia Water before the first train had left Egham. They would never have been within two miles of each other. This block system is the only safeguard against collision, and though railway managers object most powerfully to its use, we believe the day not far distant when the legislature will take the matter into their own hands, and compel railway companies, when their traffic amounts to a certain quantity, to work their traffic upon that plan. Government inspectors are ever urging its use upon them, and in this very inquest, Col. Yolland has spoken most strongly upon the point. He said:—"The danger of running trains at intervals can only be obviated by the block system of telegraph." This is the burden of every Government Inspectors' Report. The Brighton Company did not adopt it until they gained bitter experience at Clayton Tunnel. The Midland Company have been strongly urged to carry it out, and have for some time had it under consideration. The Metropolitan line strictly carry it out, and the North London have no difficulty in working their heavy traffic by its means. Other railway companies are gradually adopting it, and the South-Western will now, doubtless, take it into their deepest consideration.

The jury at Egham are undoubtedly justified, to some extent, in animadverting upon the arrangements of the railway company, but we must attribute the whole and sole cause of this frightful accident to the gross negligence of a heedless driver.

ON ENERGY.

Contributed by BLANCO MOUGREVE.

I have just read an article in the *North British Review*, on "Energy." It professes to be a popular exposition of the matter, yet it gives a rather unpleasant sneer at the fine writing of certain popularisers of scientific subjects. It seems to point to one well-known, and whose popular lectures are highly appreciated; but it is a pity that it does not contain at least some of the clearness of those lectures. There is another rather unpleasant thing in the beginning of it, namely, a decrying, I will not say of fellow-labourers, for the writer appears to me to be a dealer in second-hand wares; if he be not, then I am sorry that his article so misrepresents him. The modest Mayer is the person he particularly points at, who has been content to give us what his scientific prevoyance has seen, and what his experiments have proved, and then to retire into the dark. To the writer, theory appears to be nothing, but experiment everything! Yet is not theory of the sight, and experiment of the touch? By that at least you can walk with the head erect; but by this you must grovel and grope your way, and neither the one nor the other alone will ensure your going right. The latter deals with changes of matter: the former with spiritual laws. Together they build up our knowledge: divorced they are nothing, and worse. Did not Mayer see the indestructiblity of force as clearly as that of matter? Was it a vain imagining? I grant that Joule saw and proved somewhat, and that is better no doubt; but did not Newton see that water contained a combustible substance, and that diamond was combustible; but he did not prove these things; yet his scientific intuitions have been held up as something marvellous: and were they not? Certainly! *Malgré toi.*

What we used to call force, is here called energy; it does not much matter which be used so long as we express clearly what we mean.

There is said to be two forms of energy: *potential* and *kenetic* or "static force," and "dynamic force" according to some, or which is perhaps clearer "force in effort" and "force in act;" however, if potential and kenetic energy be adopted by scientific men, well and good.

The first thing that strikes us as of apparent value is the enunciation of the laws that govern energy in all cases. They are three:—1st. *Conservation;* 2nd. *Transformation;* 3rd. *Dissipation.*

1st. "The conservation of energy simply asserts that the whole amount of energy in the universe, or in any limited system, which does not receive energy from without, or part with it to external matter, is invariable."

There is Law the first. I do like a law; it is like firm ground to the sole of one's foot: but I *should* like to understand this one, as the writer meant it; that is, perhaps, hopeless though. However, let me set down what it says to me:—That in every system the energy therein remains invariable, if none be received from without, and none be given out from it to external matter. That is a self-evident proposition if you like, but not much of a law. I think it may be classed with "That which *is*, *is*," and "A thing cannot both *be* and *not be* at the same time." As to the meaning intended, I feel constrained to give it up, and will proceed to

Law 2nd. "The *transformation of energy* is the enunciation of the experimental fact, that, in general, any one form of energy may, by suitable processes, be transformed wholly or in part to an equivalent amount in any other given form. It is subject, however, to limitations which are supplied by the *dissipation* of *energy*."

In the first place, I was not aware that a law was the "enunciation of an experimental fact." I always thought that a law was the embodiment of the generalisation of many series of experimental facts. What is still more astonishing, the same law is said to be subject to limitations. A generalisation subject to limitations! Can it be imagined? I know that some people say that the "exception proves the rule," but as I understand Law, the exception or limitation simply disproves the pretended law. Have nature's laws any exceptions or limitations? But what are our enunciations of laws worth, if they be not the enunciations of nature's laws. They are simply delusions. Let us first strive to find out nature's laws before we pretend to enunciate any.

Third Law. "*The dissipation of energy.* No known natural process is exactly reversible, and whenever an attempt is made to transform and re-transform energy by an imperfect process, part of the energy is necessarily transformed into heat and *dissipated* so as to be incapable of further useful transformation. It therefore follows, that as energy is in a state of transformation, there is a constant degradation of energy to the final unavailable form of uniformly diffused heat, and that this will go on as long as transformations occur, until the whole energy of the universe has taken this final form."

This third law, or limitation to second law, or whatever it may be, is a strange enunciation after the other two strange ones. It leads one almost to ask does the writer mean, firstly, that *energy is indestructible*, and, secondly, that *energy is transformable.* If he does, then energy, under no circumstances, can be destroyed, and if it is transformable, then we should like to know under what conditions. He tells us there are but two forms of energy, *potential* and *kenetic.* But the very essence and nature of energy is to produce change of state or change of place, and it must of necessity be always producing such change or in effort to produce such change; but if in effort only and not in actuality, then it is because there is some equal and opposite energy resisting. This latter is what he calls potential energy, the former kenetic energy. Now clearly it must be under the kenetic form or condition that it is transformable, as it is impossible for transformation to take place when it is in the potential or static condition.

But in which of these forms is it that energy becomes dissipated, or unavailable? Is it the kenetic form? I should think not; for that is *force in act*, which is change, and not dissipation, and is still as available as before though in another form. Still less can it be the potential form; for here we have two opposite forms of force opposing, and waiting for us to upset the balance and utilise them. Coal, and food, and in fact the whole of chemistry, are examples of this, besides man's mechanical contrivancs, and all force in act give examples of the former, but not of dissipation, but change. What then can be the meaning of the dissipation of energy; it is not made clear by the writer, and looks to me somewhat like an impossibility. I will give up the attempt to understand the writer's three fundamental laws, if, indeed, they are understandable at all, and just look at one or two of his "semi-historical cases."

Speaking of the excitation of electricity by the electrophorus —an electrophorus is a cake of resin and a copper disc—he says:—"When *any* two bodies are brought into contact, there is a certain amount of exhaustion of the potential energy of chemical affinity between them, and the equivalent of this is partly at least developed in the new potential form of a separation of the so-called electric fluids."

Now who says that there is chemical affinity between resin and copper? It strikes me that Fownes does not say so, nor any one but our learned author.

I will not attempt to say what is or is not possible, but simply ask, is it proved by an experiment of our author, or any one he knows? If not, I should just remind him of the "famous Tenterden steeple." I can agree at least with the author in his disbelief in the "so-called" electric fluids, seeing that a fluid cannot be simply energy, but must be energy and something more; yet he still goes on talking about the two electricities, as if he believed it all the time. He says:—"We have already noticed that contact of two bodies, such as zinc and copper, developes a constant difference of potential between them. From the explanations subsequently given, with reference to the potential, we see that this is equivalent to saying that at the surface of contact there is perpetually a force tending to separate the two electricities in a direction perpendicular to that surface, while at points ever so little within either of the bodies, there is no such force."

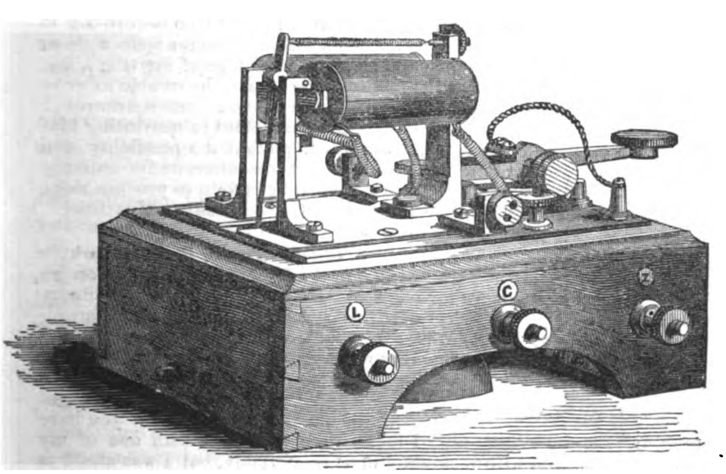
Now, mind you, our author never theorises, but builds everything up on the most rigid experiments, and no doubt in due time he will publish his experiments, upon which all this and much more like it is founded. At any rate he has settled the dispute between the contact and chemical theorists. It is to be hoped that the author is better informed respecting most subjects that he writes about, than he seems to be about Mr. Holmes' magneto-electric machine; he describes it as being formerly at the South Foreland, but does not seem to know that it is now at Dungeness, and he makes the magnets revolve before the spores, which they never did.

It is a pity but that popular writers on scientific subjects would first make themselves masters of the subjects about which they wish to write, not by cram, but really to know what they would say, and then try if they cannot express it simply and clearly, or leave it alone altogether.

Hoping, sir, that if you see fit to publish this, some one competent to handle the interesting subject, about which the writer in the *North British Review* professes to treat, will take it up and give us a thorough exposition of it; and I know of no place so suitable as your journal, as it is mainly concerned about the utilisation of two of the principal forms of force or energy, electricity and magnetism.

RUDALL'S ELECTRIC TRAIN SIGNALLING BELLS ON THE LONDON, CHATHAM, AND DOVER RAILWAY.

THIS bell is decidedly one of the simplest construction, consisting merely of the usual horseshoe electro-magnet, with an armature which is supported on pivots and works to and fro accordingly as it is attracted by the electro-magnet, or acted upon by the adjusted spiral spring. The hammer which strikes the bell underneath the case is attached to the armature by a piece of stout wire about six inches in length. The bell can be rung with the same battery power at a distance ranging from three or four up to ten or twelve miles, which is a great advantage in practice, as it gives the power of cutting out small intermediate stations at night without interfering with the station to station system of signalling which is there carried out between the larger stations. After the line and battery connections are properly made, all that is necessary to transmit a signal from one station to the other is to press the tapper firmly down for about a second, by which means one pole of the battery is brought into contact with the earth, and the other pole with the line. Now as, when the bells are at rest, the line is always in communication with the earth through the electro-magnetic coils, on depressing the tapper at either station, the circuit is completed, the armature attracted by the temporary magnet, and the hammer sharply struck against the bell below.



The system of train signalling by bells of a somewhat similar description to the above has been successfully practised for many years upon the South Eastern Railway, under the superintendence of Mr. C. V. Walker, F.R.S., who originated and introduced it. During the time it has been in operation on the London, Chatham, and Dover Railway, we understand it has been worked with the most satisfactory results.

The system adopted where these bells are used for train signalling is as follows:—

One blow given and acknowledged once, for all up stopping and goods trains *out*—(*i.e.*, about to leave a station.)

One blow given and acknowledged *twice*, for all *up* special, and non-stopping trains, or engines *out*.

Two blows for all *down* stopping and goods train *out*.

Two blows given and acknowledged *twice*, for all *down* special, and non-stopping trains *out*.

Three blows for all trains and engines *in*.

The in-signal not to be given until the station is clear, and ready to receive another train on the same line; and no train or engine to be started from a station until the *in*, or all clear signal, has been received for the preceding train.

Four blows, a special signal at junctions, &c.

Five blows—*Danger Signal*—to stop everything on the line, to be used in all cases of obstruction, shunting, &c.

Three blows given and acknowledged *twice*, the *all clear* signal.

Seven blows, for calling attention to the speaking instrument.

Eight blows, signal to test the bells.

In all the above cases, every signal received is to be immediately acknowledged by repeating back the same number of blows as received; and no signal is to be considered as sent until so acknowledged, after which it is to be booked without delay. These bells are equally adapted for stations where Clerk's block-needle instruments, or other systems requiring a bell in addition, are used. Besides calling attention to the block instruments, &c., they enable the signalmen to indicate the description of train about to start.

Should the bell fail, the above regulations, as to the progress of trains and engines, are to be carried out by means of the speaking instruments; and should telegraphic communication be wholly stopped, the progress of trains and engines must be regulated in strict accordance with the general rules of the Company for working the line by means of the Semaphore danger-signals only, with this addition, that every train and engine must be stopped, and the driver and guards verbally cautioned by the station-master that the preceding train has not been telegraphed "In," and that a good look-out must be kept.

MEMOIRS OF DISTINGUISHED MEN OF SCIENCE OF GREAT BRITAIN, LIVING IN THE YEARS 1807-8.*

By WILLIAM WALKER, Jun.

THIS little handbook was originally intended as a key to a very beautiful historical engraving by Mr. William Walker, assisted by Mr. Zobel, from a design by John Gilbert, of an assemblage of fifty-one eminent men—astronomers, chemists, engineers, electricians, mechanical inventors, and naturalists (many of them still in the land of the living), grouped in the library of the Royal Institution. The memoirs, however, proved so exceedingly attractive that the publishers, having made several additions to the list of England's worthies, have reprinted the volume, which, with the suggestive introduction by Robert Hunt, F.R.S., will be read with interest and profit. The author lays no claim to originality, as most of his subjects have been in their turn "men of mark," but he has most judiciously compiled and arranged a series of pen and ink portraitures of which the nation may well be proud; they are necessarily brief, but the leading features in all the biographies have been concisely wrought, and the volume may be considered a *multum in parvo*. In order to give our readers an idea of the little *brochure* now before us, we will not extract from the author, but give a sketch, as we find it, of one of the pioneers in the art of electro-telegraphy:—

FRANCIS RONALDS, F.R.S.

Francis Ronalds was born in London, in the year 1788. From a very early period in life he devoted himself to the advancement of electrical science, a course he has consistently pursued during a large portion of his life, which has not yet we are glad to be able to state drawn to its close. He is the inventor of an electric telegraph, electrical machine, electrometer, a new mode of electrical insulation, a pendulum doubler, an electric clock, several meteorological and magnetical instruments and other mechanical contrivances. The year 1816, however, marked Mr. Ronalds' great achievement in the advancement of electric telegraphs. During that year he was the first to demonstrate that they could be practically and unerringly applied to the passage of messages through a long distance. Well aware of the difficulties arising from imperfect insulation, which had baffled his predecessors, Mr. Ronalds secured the success of his apparatus both by employing better means of insulation than had hitherto been adopted, and also by making use of a form of apparatus which should of itself be capable of supplying any loss of electricity which might arise from defects in the insulation.† Mr. Ronalds placed his telegraph wire in glass tubes surrounded by wooden troughs lined with pitch, which were placed in a trench dug in his garden at Hammersmith. He also suspended eight miles of wire by silken cords from a wooden frame erected on his lawn, through which he was enabled to successfully pass messages except in wet weather, the cords not being protected from the wet.

Mr. Ronalds' peculiar form of apparatus may be thus briefly described:—At two stations were placed two clocks, with a dial with 20 letters placed on the arbour of the second hand; in front of each of these dials was placed a screen with a small orifice cut in it so that, as the dial revolved, only one letter could be seen at a time. The clocks were made to go *isochronously*, and were started at the same instant with the same letter appearing on the dial through the orifices of each of the screens, both dials, therefore, as they revolved, would of course continue to show similar letters. This formed the readable index of his telegraph; means of communication between the two stations were produced in the following manner:—connected with each end of the telegraph wire, and placed in front of the clocks, were two pith ball electrometers, upon which a constant stream of electricity, produced from an ordinary frictional machine, operated and consequently kept in a state of divergence, except when a letter on the dial was to be denoted; the electricity was then partially discharged by breaking the connection, the pith balls in a measure collapsed, and the distant observer was thereby informed to note down the letter then visible through the orifice on the screen.

* London: E. & F. N. Spon, 16, Bucklersbury.

† This peculiarity of Mr. Ronalds' apparatus is stated in full by Mr. Highton, C.E., in his work on the "Telegraph," page 50. London, John Weale.

In this way letter after letter might be denoted and intelligence of any kind conveyed. All that was absolutely required for the success of Mr. Ronalds' telegraph was, that the clocks should go isochronously *during the time* intelligence was being transmitted, for, by a preconcerted arrangement, both clocks might be easily started at the same letter upon a given signal. The attention of the distant observer was called by the explosion of gas by means of an electric spark. In 1823, Mr. Ronalds published a full description of his telegraph, in a work entitled, "Descriptions of an Electrical Telegraph, and of some other Electrical Apparatus."

In 1825, Mr. Ronalds invented a perspective tracing instrument, to facilitate drawing from nature or from plans and elevations, an account of which he published in 1828, in a work entitled "Mechanical Perspective." With this machine he was enabled some years afterwards (in 1835), assisted by Dr. Blair, to procure exact perspective projections taken from given noted stations, of the Celtic remains at Carnac in Brittany. The result of these researches was published by Mr. Ronalds and Dr. Blair in 1836, and was entitled, "Sketches at Carnac; or, Notes concerning the present state of the Celtic Antiquities in that and some of the adjoining Communes." In connection with this tracing apparatus, he likewise contrived a hexipod staff used for a support, and which has been much employed for the support of instruments requiring great steadiness, such as telescopes, theodolites, cameras, &c. In the year 1843 he became the first and honorary director of the Kew Observatory, and while occupying this office he supplied the observatory with various new contrivances, for which he received a government reward from the special service fund, and a small pension from the civil list. The most considerable of these contrivances were his atmospheric electrical conductor and its appendages, adopted at the Greenwich, the Madrid, and the Bombay magnetic observatories; his photo-barograph, and two photo-thermographs, adopted at the Radcliff observatory, Oxford; his photo-electrograph, and three photo-magnetographs. Besides the writings above-mentioned, Mr. Ronalds is the author of an article in the *Philosophical Magazine* of 1814, entitled, "On Electro-galvanic Agency, employed as a moving power, with descriptions of a Galvanic Clock;" and other articles in the same journal, detailing his original experiments to illustrate the relations of *quantity* and *intensity* in the electric pile. He also wrote four Reports on the Kew Observatory, which were fully illustrated and printed in the reports of the British Association for the years 1845-50-51 and 52; and one paper in the Philosophical Transactions on "Photographic Self-registering Meteorological and Magnetical Instruments," written in 1846 and printed in the year following. In 1856 Mr. Ronalds published in French, at Paris, a summary of these reports, with some additions, entitled, "Descriptions de quelques Instruments Meteorologiques et Magnetiques," intended to explain his instruments at the French exhibition.

Mr. Ronalds is now (April, 1864) residing at Battle, in Sussex, and during the latter years of his life has spent much time, and part of his small pension, in collecting and collating an electric library, which might be conveniently available for the advancement of his favourite science, and prove worthy of presentation or bequest to some British public institution, so as to form the nucleus of one which might approximate possibly to a complete electrical library.

THE EGHAM ACCIDENT.

The daily press has very justly made some severe animadversions on the gross negligence and cupidity which characterise the management of the South-Western Railway. We quote the following from *The Times* and the *Herald*:—

"Colonel Yolland censured the whole arrangements made by the Company to meet the pressure of this extraordinary traffic. He gave it as 'his positive opinion that the system used in conducting it on the Cup Day was most dangerous.' He did not think sufficient protection was derivable from the signals, and he condemned the practice of running engines tender foremost. It is not pretended that on the day of the accident this practice operated prejudicially otherwise than by interrupting the communication between the guard and the driver, and even this interruption, as we have remarked, would probably have produced no mischief if the stoppages of the two trains had been known to both drivers. Still, the practice is undoubtedly a bad one, for it disturbs the adjustment of weight as originally designed, and it deprives the driver of the protection of the weather-board. There should certainly be turn-tables at Ascot as well as at Reading, because during the race week the Ascot station becomes virtually a terminus. For the rest, it is perfectly plain that every conceivable precaution is imperatively required when heavy trains running at great speed are started in such quick succession. The Company relied upon special instructions and multiplied signals, neglecting telegraphic communication between station and station, and dispensing even with the ordinary communication between guard and driver. These omissions, in the opinion of the jury, coupled with the lack of prudence in leaving the drivers uninformed, constituted 'general mismanagement' on the part of the Company, and left its erring servants 'under great disadvantages.' In other words, though the engine-driver and fireman of the second train were guilty of culpable neglect, there was considerable excuse to be made for them. That is the essence of most of these stories. If everybody did his duty under every imaginable circumstance without error or neglect, things might all go well; but with the first omission or fault they are liable to go wrong. The moral is that precautions should be so multiplied as to reduce to a *minimum* the risks which in default of perfect service must be sometimes expected."

"We are no advocates of vindictive verdicts; we believe that in many instances shareholders have been made to pay unfairly for the damage done by unavoidable disaster; we think that they frequently suffer for incompetence, neglect, and ignorance at the Board of Trade, but the want of a turn-table at a necessary point is not to be excused; the driving of locomotives tender first, which destroys the chance of precaution, is unpardonable; the absence of telegraphic communication can be justified under no circumstances whatever; while the confusion about stoppages, both at Egham and at Staines, exhibits an unwarrantable amount, so to speak, of practical levity, which language is hardly strong enough to condemn. We are anxious, while saying this, to do no wrong to the general direction of the South-Western Railway."

The following correspondence appeared in *The Times* on the 29th ult., in which it will be found that the valuable assistance the electric telegraph is capable of rendering to the traffic on railways is recognised by the secretary of the railway company on whose line the accident occurred, but its non-employment is excused on the ground that it would occasion delay, and give the public cause for complaint:—

To the Editor of the Times.

Sir,—Having read your excellent article relative to the accident on the London and South-Western Railway, I thought perhaps you might like to have the opinion of the secretary on the matter, and, as I do believe that it accords with that of the public, perhaps its insertion might induce those who value their safety more than the nominal advantage of arriving a few minutes before others on these great occasions to take the trouble to write to him to say as much; and perhaps the numerous remonstrances I anticipate that he would receive might have some effect in convincing him that the constant use of the telegraph would prevent the possibility of a verdict of manslaughter being returned against the directors for ordering their men to do that which will, sooner or later, be certain to produce more collisions.—I remain, sir, your obedient servant, Charles Mayhew.

June 28.

"6, Chester-terrace, Regent's-park.

"Sir,—As I have some little interest in the London and South-Western Railway, which by reference to your books you will find, I take the liberty of asking why you do not telegraph from station to station before starting the trains, and by so doing prevent the possibility of an accident. By not allowing one train to follow another until the preceding one has left the next station these fearful collisions could not take place, for which you not only pay enormously, but you do away with all confidence in your arrangements. On the Continent they adopt the plan I mention, and, if you have not, it is high time you did. I went down and back with one of my daughters on Tuesday by your train most comfortably, but I was afraid to take my other daughter to-day, because I could give her no assurance that another accident might not occur.—I remain sir, your obedient servant,

"Charles Mayhew.

"To the Secretary of the London and South-Western Railway Company."

"London and South-Western Railway, Secretary's-office, Waterloo-bridge Station, London, S., June 10, 1864.

"Sir,—I have to thank you for your note and its suggestions as to greater use of the telegraph than we at present adopt. The plan you have suggested is not of so easy a nature as you would suppose, and in practice would in so many instances tend to delay trains that I am certain the public would complain. Even now the slightest detention of trains is made a source of complaint, which would be immeasurably increased if the system of running only a single train at a time on the portion of railway between two stations were to be adopted.—I am, sir, your obedient servant,

"Frederick Clarke, Secretary.

"C. Mayhew, Esq., 6, Chester-terrace, Regent's-park."

Character.—There is a truthfulness in action as well as in words, which is essential to uprightness of character. A man must really be what he seems or proposes to be. When an American gentleman wrote to Granville Sharp that, from respect for his great virtues, he had named one of his sons after him, Sharp replied, "I must request you to teach him a favourite maxim of the family whose name you have given him: *Always endeavour to be really what you would wish to appear*. Once Cromwell said to Bernard—a clever but somewhat unscrupulous lawyer, "I understand that you have lately been vastly wary in your conduct; do not be too confident of this; subtlety may deceive you, integrity never will." Men whose acts are at direct variance with their words command no respect, and what they say has but little weight; even truths, when uttered by them, seem to come blasted from their lips.

THE PERSIAN GULF TELEGRAPH.

OUR readers are fully acquainted with the facts contained in the subjoined article; but as they have been arranged in consecutive order, by a gentleman deeply interested in telegraphy, we reprint them from our contemporary the *Engineer* as historical records.

We have much pleasure in announcing to our readers the safe submergence of the entire length of the Persian Gulf cable, and as the work is one of considerable importance, and has many points of novelty in the whole method adopted in carrying it out, we shall give a somewhat detailed account of the whole work with which we have been favoured.

It will be remembered that in the spring of last year the commencement of a submarine telegraph cable for the Persian Gulf was announced in several of the morning papers. The cable was to be submerged between Fau, near Bussorah, at the head of the Persian Gulf, and Gwader, on the Meckran coast, about 250 miles west of Kurrachee. At the same time a land line was being rapidly completed between Kurrachee and Gwader, while at the head of the Gulf a party of Royal Engineers were sent out to erect a land line between Fau and Bagdad.

Between Bagdad and Constantinople the land line has been completed for the last two years by the Turkish Government, but has never yet been of much practical use, partly on account of its stopping short at Bagdad, and partly through the line not being as yet brought into a thorough state of organization.

It was originally intended that the submarine line should be laid between Gwader and Fau, relying only on the Gwader and Kurrachee land line (commonly known as the Meckran telegraph) as the connecting link between Kurrachee and Gwader. It was, however, urged by Colonel Stewart, the director of the whole line, and chief adviser to the Government in this matter, that it would be more prudent to carry out sufficient cable to lay between Kurrachee and Gwader as well as between Gwader and Fau. Because, firstly, the Meckran line, running as it does through a wild, difficult, and rugged country, was liable to interruptions; and if these interruptions became frequent or of long duration, it would be difficult for our Government to bring pressure to bear on the Porte, with regard to the efficient maintenance of the land line between Fau and Constantinople, so long as this important portion of the British line was itself in an unsatisfactory condition. Secondly, because if any one of the ships carrying the cable were lost on its passage from England to the Persian Gulf, there would still remain sufficient cable to lay between Gwader and Fau; the Meckran land line being sufficient in such a case to form—for a time at least—the remaining link between Kurrachee and Gwader, until more cable could be brought out from England. The land line was constructed without much interference from the natives, under the able superintendence of H. K. Walton, Esq., now the general manager of the whole lines between Kurrachee and Fau; and with the exception of occasional interruptions, which have been quickly repaired, has remained in tolerable working order for the last year or so; indeed, were it not for the extremely curious and inefficient insulators which have been used and known as a patent of Sir W. O'S. Brooke, and which preclude the possibility of working the two wires as two separate circuits on account of the number of contacts which exist between the wires at the insulators on every section of the line, it may be considered as in effective working order.

To those acquainted with electric telegraphs the whole design of the posts and insulators will at once appear a mere monument of ignorance. The insulators consist of a cast-iron cap, made square on plan. For what purpose this form is assumed it is difficult to say, unless it is merely because all others have hitherto been made, without exception, circular. Inside this cap a cap of vulcanite is fixed by means of sulphur, and inside this again the supporting bolt is also fixed with sulphur. So far the insulator would pass muster, were it not that the sulphur has been carefully filled up to the very brim, so as to leave a flat surface between the bolt and the cast-iron cap, thus burying the whole of the vulcanite cap, and rendering it utterly useless, except to prevent direct contact between the bolt and cap, the whole insulating surface consisting of the flat surface of the sulphur between the bolt and the edge of the iron cap, this surface being unprotected from anything but mathematically perpendicular rain.

We thus have evidently a very bad insulator; but this is not all. It is well known that on lines of duplicate wires contact is more to be feared than a little want of insulation. To avoid the possibility of contact, therefore, on English lines, an earth wire is carried from earth up to the arm or arms, and twisted round them, so as to intercept any current between the wires, and carry it to earth. On the Meckran line, however, the arms, which are of iron and bolted together, are carefully insulated from the iron pole by three feet of wooden pole. The whole arrangement is, therefore, admirably adapted for preventing contact; the insulators are well adapted for allowing, on the smallest chance offered them of wet, a very fair conduction between the wires and themselves; and to avoid the possibility of this being interrupted by an iron pole leading to earth, the piece of wooden pole is carefully inserted between the arm and the iron pole, this insulating the iron arm from the earth.

In fact, it may be said that every care has been taken to give a chance of leakage, and further precautions are taken to ensure that the leakage thus obtained shall only be into the other wire. In fact, we cannot help remarking that, with the many excellently designed insulators which are now in use in Europe—and, indeed, on the railways in India, where the telegraph is not constructed by Government—it is a disgrace that, on a line where physical and political difficulties have been overcome, a double line of wires should only be available as a single line, through the system of insulation so strangely advocated by the late advisor to the Indian Government on telegraphic engineering. And it may be observed that the Government of India are themselves directly responsible for the wretched system of telegraphs under which the country has groaned for the last six or seven years, inasmuch as they, when telegraphs were well advanced in Europe, appointed a military doctor to do the work of civil engineers.

The wretched results are only too well known in India. The telegraph has simply become a matter of joke. As a single instance, we will only take the telegraph between Kurrachee and Bombay. A message between Bussorah and Bombay takes about five minutes to be transmitted from Bussorah to Kurrachee, through the cable just laid—a distance of about 1,300 miles; but here all certainty ends. The line between Kurrachee and Bombay—a distance, as the crow flies, of about 500 miles—is scarcely ever in working order; and when it is, the messages take on an average, without exaggeration, two days to go from Bombay to Kurrachee, or *vice versa*. Further comment is useless.

Reverting to our subject, the cable—1,250 nautical miles in length, weighing 3·75 tons to the mile—was constructed at Mr. Henley's works, North Woolwich, under the superintendence of Messrs. Bright & Clark, the engineers appointed to superintend the construction and submergence of the cable; the whole undertaking, including the selection and construction of the cable, the selection of engineers, and the construction of the various land lines, the arrangements of the stations and the permanent staff, being entrusted by the Indian Government to Lieutenant-Colonel P. Stewart, R.E.

With regard to the pattern of the cable selected we may first mention that the failure of long submarine cables in shoal water, such as the Red Sea and Mediterranean cables, has been proved on the best evidence to be principally due to the small quantity of iron used in the protecting sheath, and which again was allowed to perish rapidly through the absence of any precautions to ensure it against rust.

In the Red Sea and Mediterranean extension lines the protecting wires were scarcely so thick as bell wire, and not even galvanized; the whole cable weighing less than a ton to the mile.

These perished rapidly, as was expected by those who had experience in the maintenance of the cables around England, where the companies who possess cables have constantly laid them of larger and larger dimensions, the last laid weighing about 17 tons to the mile. The Malta and Alexandria cable weighs 2·13 tons to the mile, of which only 1·67 tons is iron, and the wire is ungalvanized and unprotected. It is curious that a cable of such a pattern, which cannot last for more than four or five years from the date of submergence without serious repairs, should have been decided on and laid, seeing that the Bonah and Cagliari cable, laid in almost the same locality and of precisely the same mechanical protection, was found broken up into short pieces by rust in about two years after submergence. This is the more to be regretted, as the core is of the most liberal proportions as regards copper and gutta-percha, and, indeed, the best insulated cable submerged up to the time of the Persian Gulf cable. In the case of the Persian Gulf cable, it is to be hoped that the precautions taken against this decay from rust will prove sufficient to ensure its effective working for many years to come. Of course the expense of transport from England to the Persian Gulf would make the adoption of a cable of the same weight and bulk as those used in the English and Irish Channels and North Sea excessively expensive, and add so considerably to the total cost of the work as to preclude, for the present at least, the adoption of a cable of such a weight; although undoubtedly the tendency will be to lay cables of a heavier description on each successive work, if in shoal water, even though undertaken abroad. It is to be remarked also that, with the exception of a few rough patches between Gwader and Kurrachee, the whole of the line lays in quite soft mud, into which all leads, anchors, and grapples sink several feet deep. The amount of anchorage, except from small native craft, is also insignificant, and therefore a very heavily proportioned cable would be unnecessary.

Still the proportions and weight of the Persian Gulf cable is 3·75 tons to the mile, of which 2·95 tons is iron. In addition to this advantage in the quantity of iron, the iron wire is all galvanized, a process which, it is well known, generally adds some years to the life of a cable. In corroboration of this it may be mentioned that, in the operations connected with the repairing and picking up of the Red Sea line in 1862, under the superintendence of Mr. L. Clark and Mr. Laws, the ungalvanized cable was found entirely perished, while a few feet off the galvanized wire was found in perfect condition. To secure the cable still more against the danger of rust, a process invented and patented by Messrs. Bright & Clark has been adopted, which, although already in use on several cables about England, has never yet been so perfectly carried out as in the present case.

Before proceeding to describe this we must give a brief description of the whole pattern of the cable. The conductor, unlike cables hitherto laid, consists neither of a single copper wire, as at first adopted in all the earlier cables, nor of a strand of three, five, or seven wires, laid up so as to form a small copper strand, as in the case of the Atlantic cable and Malta and

Alexandria. The former mode presents the disadvantages that, when the wire was brittle from unsound casting in the ingot or bad annealing, it was liable to crack, and when being paid out from the ship the two parts separating would cause a want of continuity, thus rendering the cable useless until the faulty part was cut out.

The second method obviated this danger, as it is improbable that several wires should all have brittle places exactly at the same place in the rope; but other disadvantages presented themselves, as science advanced, of a more delicate nature.

It was proved mathematically, and found in practice, that the increased amount of surface exposed in proportion to the sectional area of the copper in the case of the strand conductor, as compared to the solid wire, reduced the rate of signalling greatly. Besides which, it was found that the interstices in the strand wire permitted the water to percolate along the cable whenever an end was left open in any of the operations exposed in the sea.

To combine the advantages of both systems without their respective disadvantages, Mr. L. Clark suggested a conductor formed of four wires, whose section is each the quadrant of a circle; so that when the four are placed together they form a complete circle, and are kept in their places by a fifth part in the form of a tube encircling the four segmental wires. We thus have a circular conductor formed of five separate parts.

This system, which lessens the chance of loss of continuity, preserves all the electrical advantages of the solid circular conductor, and has been adopted for the first time on the cable we are describing. To ensure also the highest conducting power, each hank of copper was carefully tested for its conductivity, the bad being rejected and an extra price given for all copper which was above a certain fixed standard of conductivity, this standard being equal to the copper of highest conducting power hitherto used. To assist the manufacturers in the selection of their copper, Mr. Brasher, an assistant of Messrs. Bright & Clark, made a series of experiments on the conductivity of the ingots previous to their being drawn into wire at the works of Messrs. Wilkes, by whom every facility was given for these operations. The diameter of the conductor is 0·1 of an inch, and weighs 225 lbs. per nautical mile.

We now come to the insulating material. A great deal of discussion has taken place of late amongst electricians and manufacturers, relative to the respective merits of india-rubber and gutta-percha. Fierce has been the battle that has been waged at public institutions and in scientific journals by the untiring partisans of each insulating gum. Papers have been read, experiments have been made, champagne breakfasts and special trains have been provided for special meetings, with the hope of proving to engineers, electricians, and directors the superiority of one or other gum. Discussions in the press have more than once verged on the personal, through the conflicting opinions and interests of the different advocates of each particular gum. India-rubber has set forth its advantages in glowing terms, and proved over and over again that all cables insulated with percha must fail, while percha has taunted india-rubber with its utter unfitness for the purpose, until the battle of the gums has become as notorious as the "battle of the gauges." It would seem at first sight, therefore, to be a difficult matter (amongst so many conflicting opinions and interests) to decide on the best insulator for so large and important a work as the Persian Gulf cable, particularly if we take into account the number of failures which have taken place in submarine telegraphs, and which are, one and all, laid by the advocates of india-rubber in the most unscrupulous manner to the adoption of gutta-percha as the insulator.

To those who examine more carefully the evidence which has been published on this subject, it will be easily seen that those failures can be traced more to want of sufficient mechanical protection in most cases, and in others to carelessness in manufacture, or a want of skill in the operation of submergence, than to any deficiency in the insulator used. Gutta-percha has been used on many cables ever since the year 1851 with perfect success, and evidence is still wanting to show that it deteriorates when kept under water, although many cables have been lifted and carefully examined in various seas; while india-rubber, whatever part it may ultimately play in submarine telegraphy, has never yet been employed on any submarine line; and, indeed, in the only practical experiment which has been made to ascertain its durability—viz., the submergence of a length of two miles off Kurrachee—proved a complete failure.

The facts were, therefore, not such as would justify any departure from the course hitherto adopted, more especially as the Gutta-percha Company have made great progress during the last few years in cleaning and manufacturing the gutta-percha used for submarine cables, and could, it was well known, produce a far better insulator than had hitherto been employed.

Colonel Stewart, with whom rested the final decision of this matter, although well acquainted with the facts we have mentioned, prudently requested the opinions of the chief scientific authorities, among whom we may mention Messrs. Bright & Clark, Professors Thomson & Wheatstone, Messrs. Varley, Jenkins, & Siemens, the majority of whom decided in favour of gutta-percha. But although at the present time there can be little doubt as to the superiority of gutta-percha over any other substance for this purpose, still the improvements that have been made during the last three years in the preparation of india-rubber, through the untiring perseverance and skill of Messrs. Hooper, Silver, and Hall & Wells, give great hopes that the well-founded objections to the use of rubber may be, ere long, removed. India-rubber, when first manufactured, has, it is well known, superior insulating qualities, as well as a lower specific inductive capacity, and in addition will stand a greater change of temperature without affecting materially its insulating power—a quality which is of the highest importance in tropical climates.

Its chief disadvantages at present appear in a tendency to change its solid for a semi-fluid state, resembling that of treacle; in other cases it becomes hydrated after submersion. How far vulcanization will remedy this evil still remains to be proved.

But in addition to these various drawbacks, the mode of applying the material, which consists in lapping it spirally round the wire, thus forming a spiral joint the whole length of the cable, cannot (however perfect it may appear when first made) be so safe as the mode adopted in covering with the more plastic material, gutta-percha, which consists in passing it through a die for each successive coating, in which case the covering consists of a series of concentric tubes, forming a continuous and unbroken coating. The whole of these layers are cemented together during the process by a layer of insulating material known as "Chatterton's compound." How far the late attempts to remedy the objections to india-rubber will prove effective will be proved by the results obtained on the various lengths of experimental wire which Colonel Stewart has, with a laudable desire to investigate thoroughly the whole matter, taken from England for the purpose of submergence in the Persian Gulf.

The core of the Persian Gulf cable, then, consists of the conductor, which we have described, insulated with four coatings of the purest gutta-percha, united by four distinct layers of "Chatterton's compound," having an ultimate diameter 0·38 of an inch, and weighing 500 lbs. to the nautical mile (225 lbs. of copper, 275 lbs. of percha).

The core was also manufactured in much longer sections (sometimes nearly 4,000 yards in one unbroken length) than any that had been hitherto made, thus reducing the number of joints in the whole cable considerably—a great advantage, as the joints are found electrically to be the weakest points in any core. The core thus manufactured was presented to Government for testing at the Gutta-percha Works.

These tests were made by Mr. J. C. Laws, assisted by Mr. Lambert on the part of Messrs. Bright & Clark, and consisted—firstly, in a careful test by means of Wheatstone's electric balance, to ascertain the resistance of the copper per nautical mile, expressed in terms of Siemens' well-known unit of resistance; secondly, a test of the resistance of the gutta-percha, or, in fact, its insulating quality, expressed also in terms of the same unit as the copper resistance. Both these materials are affected in their conducting power by temperature to a great extent. The effect of an increase of temperature on the gutta-percha is to lessen its resistance; whereas with copper, on the contrary, the effect of an increase of temperature is to increase its resistance.

Very different results would be obtained, therefore, with the same materials at different temperatures, and thus testing at the ordinary temperature in England would be very different to that which would be obtained in the Persian Gulf.

To avoid these sources of error the wire was tested at one uniform temperature, which was obtained by immersing the coils in water kept at 24° centigrade for at least twenty-four hours previous to the test being made. The wire was also tested at the same temperature in Reid's pressure cylinders under a pressure of 600 lbs. to the square inch, which is equal to a depth of 200 fathoms, a depth far greater than that at which the cable will be submerged.

(To be continued.)

SILVER'S INDIA-RUBBER WORKS AND TELEGRAPH CABLE COMPANY (LIMITED).

An extraordinary general meeting of the shareholders of the above company was held on Thursday last at the London Tavern, Bishopsgate-street, for the purpose of obtaining the sanction of a special resolution of the company to the making of new regulations and provisions for—

First. The increase of the capital of the company by the issue of new shares; such aggregate increase to be of such amount not exceeding £500,000, and to be divided into shares of £50 each, or of such respective amounts, and to be allotted in such manner as the company in meeting shall direct, or, if no direction be given, as the directors shall think expedient.

Second. The change of the name of the company from "Silver's India-rubber Works and Telegraph Cable Company (Limited)," to "The India rubber and Gutta-percha and Telegraph Works Company (Limited)," according to the power given by the 13th section of "The Companies' Act, 1862."

Third. The substitution of the following regulation in lieu of the regulation now contained in Article 44 of the Articles of Association of the company:—"All capital and all other moneys of the company not immediately applicable for any payment to be made by the company may be deposited or invested by the directors in or upon such personal or other securities or investments, other than stock or shares of the company, as the directors from time to time think proper."

Dr. Beattie occupied the chair.

The SECRETARY having read the advertisement convening the meeting,

The CHAIRMAN remarked that he had great pleasure in meeting them so soon after the formation of their company, which had for its object the extension of the works of Messrs. Silver & Co., in the manufacture of articles of india-rubber, to which was to be added that of gutta-percha, as well as the new gum, balata, which was likely to become an article of great commercial importance. It having come to the knowledge of the board that another company, with powerful support, was about to be formed to work gutta-percha, they felt that if it had been started it would have produced serious competition with this company; they therefore deemed it desirable that arrangements should be attempted to produce a fusion of the two interests, and they are glad to report that such a fusion had been accomplished, and thereby competition had been prevented, whilst very considerable collateral advantages would be obtained. When he mentioned that by this amalgamation Messrs. Harvey and Henderson had been added to the board of directors, they would at once perceive that the board had been very much strengthened thereby. Messrs. Silver having learned that the proprietors of the india-rubber and gutta-percha factories of France and Belgium were in some difficulties, it was thought advisable to ascertain on what terms these works could be purchased, and after some great degree of trouble, and the visit of some of the directors to Paris, it was agreed to purchase the works in Paris and Belgium, and an amount of £65,000 has been paid for the freeholds and the works, and a concession has been made by which the proprietors may acquire £100,000 in shares in the company's works. It was also most important to state that no promotion fee was to be paid to Messrs. Harvey and Henderson. The next question he had to refer to was the nominal capital. It was evident that the extended works could not be efficiently carried out with their present capital; it was therefore proposed to increase it from £500,000 to £1,000,000, and to allot £250,000 of new issue, of which the French company was to have the option of taking £100,000, and the new gutta-percha company £150,000, of which they had pledged themselves to take £100,000, leaving the other £50,000 for disposal amongst their friends. It would, therefore, be very obvious that their company would acquire great strength by that arrangement. They had not brought the new gum, balata, much before the public at present, but they expected very much from its introduction; and he might remark, that at the late distribution of prizes at the Society of Arts, by his Royal Highness the Prince of Wales, the silver medals of the Society were presented to Sir William Holmes, and Mr. Walker, of Demerara, for introducing it to public notice—a fact which spoke favourably for the gum itself. The next thing he had to bring before them was the change of the name of the company from that of "Silver's India Rubber Works and Telegraph Company, Limited," to "The India Rubber and Gutta Percha and Telegraph Works Company, Limited," which had been necessitated by the amalgamation of the new company with theirs. Within the last three months the business of the company had increased twenty per cent. over that of the same three months last year, whilst in one department, since May, 1863, the operations had been trebled. The unfortunate fire, some time since, at Silvertown, had caused some anxiety to the shareholders, but he was enabled to inform them that the damage had caused very little interruption to the works. The whole has been covered by the amount of insurance and salvage, with the exception of a small sum, which Messrs. Silver had, in the most handsome manner, taken upon themselves, which he thought it right the shareholders should be made acquainted with. The next part of the business of the meeting, relating to the investment of the capital at the disposal of the directors, had been rendered necessary by the regulations of the Stock Exchange.

The CHAIRMAN having read the whole of the resolutions, concluded by proposing the first, relative to the increase of the capital.

J. W. WILLANS, Esq., explained, in answer to a Shareholder, that only £250,000 worth of shares had been issued in the first instance, and that, supposing that the French Company took up the whole £100,000 which had been apportioned for them (of which the Board were not certain), and Messrs. Harvey and Henderson the £150,000 set apart for them, there would still be opportunity for further investment in the remaining shares of the company.

J. G. T. CHILD, Esq., in seconding the resolution, said that on account of the new arrangements made it was found necessary to have a much larger capital than was originally intended; they were bound, however, to keep faith with their shareholders, by not issuing new shares, and by not making calls more rapidly than they had engaged to do. It was therefore suggested that, as they could not issue these shares, they must create new ones; and they had determined upon the creation of £250,000 in new shares, and thus leave the original in *statu quo*. He thought that the proposition would be found desirable, so that they might be able to make calls as they required money, which, he thought, would be found better for all parties.

The resolution having been put to the meeting, was carried unanimously.

The second resolution, relating to the change of name of the company, having been moved by the Chairman, and seconded by Mr. M'Clure, of Manchester, was also carried unanimously.

The CHAIRMAN having moved the next resolution, relating to the cash in the hands of the Directors, stated that on account of the progress of telegraphy in the East, they contemplated that a very large and profitable business was likely to be done almost immediately in that department.

Mr. ATKINSON did not consider it desirable to have so large an amount of money at the disposal of the Directors, to invest in any way they pleased. He thought they ought to deposit it at the bankers.

The resolution having been seconded, was put to the meeting, and carried unanimously.

Mr. JONES, of Huddersfield, felt that it was most satisfactory to have such an explanation as they had heard with regard to the fire at Silvertown, and it was doubly so to find that the loss had been covered by Messrs. Silver. He therefore begged to move, "That the hearty thanks of the meeting be given to Messrs. Silver, for the very handsome manner in which they had secured the Company from any loss which might have arisen from the late fire at Silvertown."

Mr. F. CASE having seconded the resolution, it was carried unanimously.

Mr. S. W. SILVER begged to thank them for the kind way in which they had taken notice of the manner in which the loss by the late fire had been met. They had great cause for thankfulness that matters were not worse than they had been. He looked with a deep sense of gratitude to Him who rules the winds, that He was pleased not to permit the whole of the place to be levelled with the ground. He could only say that they were very glad to meet the calamity in the way they had done. (Cheers.)

Mr. CHILD moved and Mr. JONES seconded a vote of thanks to the Chairman for presiding, and also for the great attention which he paid to the interests of the company, which was carried unanimously.

The CHAIRMAN, in acknowledging the vote, said, that he looked forward with confidence to a large amount of business being done by the company, not on this side of the Atlantic only, but on the other also. He then announced that the meeting would stand adjourned to that day fortnight, for the confirmation of the resolutions of the present meeting.

THE AMERICAN COMMISSIONER ON THE POLICY OF PATENTS.

(*Continued from page 306.*)

The system of granting patents in Great Britain without previous examination as to novelty has led to the granting of a great number of patents for the same thing—an evil which became so great as to lead to the publication of all the specifications, which only partially remedies the evil. Mr. Woodcroft says, "that having found so great an abuse to exist, as to granting patents for the same thing over and over again, he was led to prepare a list of those which related to the origin and progress of steam navigation." "I found," he says, "that no step in the art of steam navigation had been made which was not the subject of a patent. Among 400 patents, I found that a very few heads would comprise the whole of the inventions; for instance, of vertical paddle-wheels there have been a score of patents which are identically the same in mechanical action; for drawing water at the bow of a vessel and pumping it out at the stern there have been another score or two; then for making the float-boards of paddle-wheels move in various directions on their axes, there have been also as many patents; and for propellers in imitation of ducks' feet there has been a large number of patents." A striking instance of the evil resulting from this system is taken from Mr. Woodcroft's evidence. He says: "I have known of a patent within the last year upon which a gentleman had spent about £11,000. He came and consulted me, and wanted me to go and look at a boat he had been constructing. I said, 'It is of no use. I have seen the drawing, and the invention is as old as the hills, and you will never drive the boat six miles an hour; in addition to that, the invention is not yours—it has been patented over and over again.'" Mr. Hodge, an English patent agent, who had personally witnessed the practical working of our system of examination and heartily approved of it, speaking of the English practice, says: "Many inventors have been ruined in consequence of taking out patents under our (the English) system; whatever amount the patent may have cost the inventor, it may be assailed the very next hour. I can refer to a case in which a patent was tried before a special jury; upon their decision being given, the patentee went out of court saying he was a ruined man. And if he had not had a few friends to come and support him he would have been ruined. If the Government had appointed a board of examiners to examine his patent, and to show him that it was not quite original, and that there was a little infringement upon another patent, he would not have had occasion to go to this great cost."

The evils of this system were many years since pointed out in an able article on patents published in the *Edinburgh Encyclopedia*, and written by Mr. Simpson, under the direction and sanction of the eminent philosopher, Sir David Brewster, himself a patentee, whose beautiful optical toy, the kaleidoscope, some years ago, used to delight so many thousands of children, and even wise men, with its wonderful changing polychromatic beauties. This writer, after a severe reprobation of the then existing system of patents, observes, "The causes of these aggravated mischiefs are both before our readers, when we say that patents ought not to be granted *of course*, and 'at the hazard' of the patentee, but *causa cognita*, by a sufficient and competent authority." He continues: "The expression is common, that a patent may be got for anything, but very few are found good when they come to the ordeal of a jury. Is not this saying, in so many words, that many that have ought not have been granted, and that it is unworthy of this great country to pervert a valuable privilege, and confound the trash of every

pretender, whose end is answered by a mere patent mark, with those inventions which illustrate the genius and exalt the character of the people?"

More than thirty years afterwards Sir David Brewster declared that his opinions were clearly expressed in the article above quoted, that the protection of patents ought only to be extended to *new* ideas, and that he would ascertain the novelty of such ideas by means of a board of commissioners composed of scientific persons. It is due to the pervading knowledge that a patent in Great Britain is not even *prima facie* evidence of the originality of an invention, and that it is of little value, except to give the patentee a status in the courts until it has passed a judicial ordeal, that such severe litigation exists in that country in relation to titles to inventions. The costs of such litigation are sometimes frightful. Two startling instances are related by Sir Hugh Cairns in the speech in the House of Commons before referred to. A patent had been taken out by an eminent manufacturer in Sheffield for an invention which effected a revolution in the manufacture of steel by the introduction of a chemical substance, and enabling steel to be produced at a reduction of 30 or 40 per cent. on the previous cost. Mr. Heath, the alleged inventor, from the time he obtained the patent, in 1842, till he died, in 1853, spent his life in litigation. The suit was formally carried to the House of Lords, and he obtained a statement which showed that the costs of the defendant were estimated at £7,000, and those of Mr. Heath at £8,000, showing that the two sides had expended in litigation connected with a single patent the sum of £15,000. It appears by the statement of a writer in the London *Quarterly Review* that this patent was extended in 1853 for the benefit of Mrs. Heath. In August, 1853, Mrs. Heath brought an action against an infringer, and *then, for the first time*, credible evidence was given that the invention was not new at the date of the original patent. A patent was taken out in 1850 or 1852 by a Scotch gentleman named Menzies for capsules and tops of bottles. The invention being a very valuable one, litigation in connection with it was carried on both in Chancery and in the courts of common law. After, according to Mr. Montagu Smith, a verdict in favour of the patentee, the case was taken to the Queen's Bench, where the patent was defeated on the ground that an *old patent had been discovered* in the office by which the invention had been anticipated. Finally, the case was carried by appeal to the House of Lords, where, in 1862, it was still pending. Sir Hugh Cairns stated that the solicitor to the plaintiff informed him that the costs of his client amounted to £14,487, and he estimated those of the defendant at £10,370. So that the total costs of legal proceedings in connection with the invention amounted to not less than £24,857. The legal expenses connected with these two patents, which might have been saved to the unhappy litigants by a system of preliminary examination, was £39,857, or about $199,285, about $10.000 more than the total expenses of this office for the last year—viz, $189,414 14c., which, during this period, has made examination of 6,014 applications. Of these applications, 1,844 were refused, principally upon the ground of a want of novelty, while 4,170 patents have been granted. It is not pretended that errors from unsoundness of judgment or insufficiency of investigation may not have occurred in these decisions. But I feel confident that, as the general result of our system, its benefits have accrued no less to the unsuccessful than to the successful applicants; that while the latter have secured patents to which an intrinsic value has been imparted by the scrutiny to which the inventions have been subjected, and by the sanction of the office are comparatively protected from infringement and litigation, the former have been saved from waste of time and labour upon well-known machines, and from the cost and misery of defending in courts of law rights to which they could maintain no title. This view of the benefit of a system of examination in preventing infringement and litigation is fully borne out by observation in Prussia, where there is an admirable plan of examination as to novelty by a board of patent commissioners, each one of whom is selected for his proficiency in some special department of the arts. Mr. Weddinge, a member of the Board of Trade of Prussia, as well as a member of the patent commission, stated, before the committee of the House of Lords, that in Prussia there are very few infringements of the patent rights of patentees, and that manufacturers generally prefer to get permission of the inventor to use his right under the patent. It is true that litigation to no inconsiderable extent will always exist in this country, where such vast capital is invested in patent property, and especially in relation to questions of interference, or those where the question of priority arises between two inventors, both of whom may have been original authors of the discovery; but the amount of present litigation is trifling compared with the vast number of patents issued, and the value of property based upon them. I assume merely that litigation is most materially prevented by our system of examination. If even this is true, it is the highest commendation of our system, for, as Lord Langdale, the late Master of Rolls in England, says, "It is the great object of good legislation to cut off the causes or sources of litigation; that I conceive to be the object of Government." It is the duty of patent agents, who now form so important a class of professional men in this country, not too earnestly to press doubtful applications, and not to demand of the office a liberality in granting patents, which, if carried too far, would destroy the system which is the foundation of their business. It is the duty of the office to conscientiously and rigorously scrutinize every application, and to be sure that no patent is granted for anything which is not absolutely new, and at the same time to see that the applicant shall have the benefit of whatever, whether claimed or not, which is shown by specification, model or drawing, to be a new invention. That both these objects have been kept in view by the office—at least under its more recent administration—is shown by the fact that more than half of the applications upon which patents are granted are amended by the applicant at the suggestion of the office, so that he may not claim any more than has been found by the office examination to be actually new. The reasons urged by Lord Stanley and Sir Hugh Cairns, in the important debate so often referred to, that a patent should be granted after an inquiry little more than nominal and formal, it being understood that it should confer nothing more than a right to sue in a court of law, were, that it would be difficult to find men who were competent to pronounce authoritatively upon the novelty and utility of an invention, and that if scientific men were selected to compose a tribunal to pass judgment upon the novelty and utility of an invention, those inventions which were most original, and which in the end would be likely to turn out most valuable, would be most unlikely to receive scientific sanction. It was urged, for example, "Sir Humphrey Davy did not believe in the possibility of lighting houses with gas, and had he been acting as a judge, would have condemned that invention as useless." The last objection applies only to the examination as to utility, upon which with us the office does not pronounce judgment. The readiness with which persons acquainted with any particular branch of invention, and provided with facilities for investigation, can determine questions of novelty, is admitted by Mr. Woodcroft, although opposed to the system of examination. Being asked by the select committee whether, supposing he were professionally employed to determine for parties upon the novelty of their inventions, he thought he could undertake generally to determine that point with a moderate degree of time and expense, he replies, "If I had the whole of the specifications before me, I could do it in a moderate degree of time, and at a moderate expense." The facilities for determining the novelty of inventions demanded by Mr. Woodcroft are most amply provided in this office. It possesses a technological library unequalled by any in this country.* It has opened relations with nearly all the Governments in the world for obtaining information up to each current month of the progress of inventions abroad. Its portfolios of drawings, so numerous as to crowd two halls, each nearly 100 feet in length, and yet so systematically arranged that the hand can at once be laid upon any drawing sought for, and its museum of models, unrivalled by any similar collection in the world, exhibit as in an open book all that has been done in American inventions. It is the fault of the administration, and not of the system, if the plan and facilities for examination are not as perfect as human ingenuity has devised.

Another favourable point of comparison of our own with the English policy is the cheapness with which patents are obtained in this country, the cost being limited to the amount necessary to create a fund for reimbursing the expenses of the Patent-office, while in Great Britain the cost of obtaining a patent is £175—over twenty-two times the cost in this country. From the fund accumulated by these fees in five years there was deducted for stamp duties the enormous tax of £67,060. It was in relation to this great grievance that Lord Stanley said, in a pamphlet published in 1856, "One discovery checked, or even retarded by exhorbitant imposts, may cause a greater diminution of wealth, which would otherwise accrue to the nation,

* About 14,000 volumes have already been collected. Few or no libraries in the country are so complete in many of the departments of useful knowledge. The collection of encyclopedias, and of scientific and technological journals, cannot be surpassed. Of journals it possesses not only the leading ones of this country and Great Britain, but those of France and Germany, and also those in the separate departments of science and arts. For example, in photography there are 3 American, 4 English, 5 French, and 3 German. The office subscribes to 95 periodicals, and receives 75 by donation, in addition to the transactions of learned societies. Of these periodicals 69 are in the English language, 27 published in America, and 42 in Great Britain; 35 in the French language, 57 in the German, 2 in the Italian, and 2 in the Dutch. Of these, 11 relate to general science, 26 to arts and manufactures, 15 to photography, 7 to civil engineering, 7 to horticulture, 4 to mining, 6 to chemistry, 2 to chemistry and physics, 2 to chemistry and pharmacy, 34 to agriculture, 11 to literature, 3 to bibliography, 3 to statistics, 3 to mercantile affairs, 2 each to acclimatization, manufacture of paper, railroad engineering, entomology, gas lighting, patents, military affairs, and architecture; and 1 each to fine arts, microscopy, law, electricity, medicine, medicine and surgery, pharmacy, veterinary surgery, horology, coal oil, coach-making, printing, bees, botany, and geology.

During the past eight years the office has sent its reports to all the principal libraries and learned societies in the world, and received in return many valuable works, besides the regular publications of the societies. From the Great Seal Patent-office of England, for example, it has received a complete set of its publications, forming a library in themselves, consisting of the specifications of patents of the old law series, issued prior to October, 1852, to be bound in 408 volumes of 8vo letter-press, and some 350 volumes of folio plates, 378 volumes of letter-press, and 378 volumes of plates of the new law series, 35 volumes of indexes, 10 volumes of the *Commissioners' Journal*, 25 volumes of abridgments of specifications, 1 volume of appendix, and 1 volume of supplement.

To enumerate the more valuable works in this library would be a long and tedious task, as it is well supplied in all its various branches, embracing in the simple subject of photography, the literature of which is of recent growth, 144 separate and independent works, not including its periodicals. During the year 1863, 574 volumes and 114 pamphlets have been added to the library. Of these, 808 were by purchase, and 380 by donation.

As the business of the office extends and the number of patents is increased, the library will become a more and more important auxiliary. Its use is not confined to the examining corps, but is extended to the inventors of the country, and to solicitors and attorneys from the distant cities. To those engaged in the trial of patent cases before the courts it is invaluable, as it is impossible to find so complete a history of the improvement in litigation as upon its shelves.

A liberal spirit ought always to be exercised in the purchase of books, and every means taken to render the library complete, that it may at all times show the condition of the arts. Unfortunately, during the past three years, owing to the decrease of the receipts, it has been necessary to limit the expenditures, but with returning peace large additions ought to be made and improved accommodations be secured. The example of the Great Seal Patent-office, which within a few years has accumulated a library of upwards of 40,000 volumes, may well be followed.

than can be compensated by tenfold the gain actually netted by the treasury." The acknowledged object of subjecting patentees to these enormous charges is the prevention of the multiplication of worthless or frivolous patents, and patents for small improvements on valuable inventions, or combinations thereon.

The objections to the frivolity and multiplicity of patents are so often thoughtlessly made, even in this country, as to be worthy of refutation. Those who have carefully studied the progress of civilization must have observed that the uplifting of society has not been effected by paroxysmal convulsions, such as were supposed by geologists of former times to have upheaved the ancient continents at a single shock, but by causes which have operated as gradually and imperceptibly as those which modern science has shown to have actually raised within historic periods vast countries, with the whole burden of their cities and unconscious people. The progress in mechanical improvements and in science has been so gradual, that it is difficult to trace it except by the great general results. The fields of invention and practical knowledge have been extended by accretions as insensible as those which have formed the delta of the Mississippi. Every new fact in science—every new conception of ingenuity—no matter how trivial, has added something to their area. The noblest inventions which now astonish the world—the steam-engine, the cotton mill, the railroad—have been as truly built up block by block, layer by layer, as the pyramids. More than eight hundred distinct inventions were required to perfect the cotton-spinner. To refer to more recent branches of mechanical industry, we find some of the best harvesting machines protected by no less than twenty patents, each invention consisting of but a trivial improvement, yet the whole being necessary to the perfection of the machine. The art of sewing by machinery, which originated no later than 1842, has attained its almost miraculous development in this country through more than six hundred inventions, for which patents have been issued. It is by no means asserted that all these inventions have been found practically useful; but perhaps no other art can so well illustrate how, in mechanical contrivances, idea begets idea, and the invention of yesterday gives birth to the invention of to-morrow.

The apparent insignificance of an invention is no measure of its value. Inventions in the meanest of household arts, such as improvements in washing and wringing machines, have not only contributed most materially to domestic comfort, but have given rise to single manufacturing establishments employing over half a million of dollars of capital. Improvements in articles so trivial as hooks and eyes, and pins for infants' clothing, have been the foundation of patents which have produced tens of thousands of dollars.

The application, in a manner to be hereafter described, of a *pencil mark* in submarine blasting, and the explosion of military mines by the electric current, enables the operator to dispense with cumbersome and costly batteries and machinery formerly indispensable. A spring for holding the deflector and chimney upon a coal-oil lamp, consisting simply of a bent strip of brass, has gone into universal use, and through a tariff of a few mills upon each lamp to which the invention is applied, has yielded several hundred thousand dollars to the inventor. The more minutely the arts are studied, the more will the conviction be forced upon the mind that, as the distinction between great and small appears to be unrecognized by Providence, the distinction between important and trivial, and useful and worthless, should never be applied to any original work of human ingenuity.

This is the doctrine of Sir David Brewster, who believed that "patents should be granted for every new idea, whatever that idea might be; that every encouragement should be given to persons to bring forward such ideas; and that, instead of throwing difficulties in their way, even when the ideas appear to be frivolous, every facility should be given for their development, because they may contain the germ of future inventions. They may contain ideas which will suggest others more useful and practical; and what is a simple and amusing experiment in one age may become a great invention in another."

(To be continued.)

CORRESPONDENCE.

JOINTS IN TELEGRAPHIC CORES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I am glad that you have called attention to the above important subject. There can be no doubt but that several thousand miles of submarine lines have failed owing to the slovenly and imperfect manner in which the joints were made. The greatest care should be exercised in the making of joints in both gutta-percha and masticated india-rubber covered wires. Good, efficient, and permanent joints are practicable in either material; not so, as you observe, with virgin rubber, vulcanised rubber, Wray's compound, and many other materials. Neither an efficient or permanent joint has ever yet been effected. I believe that the unsatisfactory condition of the line between Kurrachee and Bombay, as described in your last number, is owing to the imperfect insulation of a short cable, consisting of a combination of virgin and masticated rubber, lately submerged as a part of that line, the condition of which cable joints were the subject of conversation amongst electricians previously to its leaving our shores. To show the importance attached to the proper rendering of a joint, the following extract from the evidence of Mr. W. Smith, before the Submarine Telegraph Committee, will suffice:—" Capt. GALTON: Is not the making of the joints the most difficult part of the manufacture?—Mr. W. SMITH: It requires great care. Capt. GALTON: Do you employ peculiarly skilled men for that purpose?—Mr. W. SMITH: We have men who do nothing else."—Yours truly,

June 28, 1864. A. J. T.

TELEGRAPHIC NEWS.

BALATA.—At the annual meeting of the Society of Arts, held at Willis's Rooms on the 27th ult., his Royal Highness the Prince of Wales, on behalf of the council, presented the silver medal of the society to Sir William Holmes for the introduction into this country of the above valuable material as a substitute for gutta-percha and india-rubber for insulating and other purposes.

MERIT REWARDED.—We are glad to find from an intimation contained in the *Moniteur Universel* of the 24th inst., that his Imperial Majesty the Emperor of the French has conferred upon Professor Hughes, the inventor of the well-known instrument which bears his name, the honour of a chevalier of the imperial order of the Legion of Honour. We heartily congratulate the distinguished electrician on this additional recognition of the valuable services rendered by him to the science of telegraphy.

THE PERSIAN GULF TELEGRAPH.—We are glad to be able to announce the safe arrival in England of Sir Charles Bright, and to report that his labours in laying the line which is to connect Europe with India have been eminently successful. The gentlemen of the staff have not yet arrived, but are expected in a few weeks. Mr. F. C. Webb remains in India to superintend the preliminary working of the line.

WEST INDIA ISLAND TELEGRAPH.—It is stated that a proposition has been lately made to connect most, if not the whole, West India islands by telegraph with the Mainlain at Cayenne, in French Guiana, at Key West, in Florida, if a grant of £6 per cent. on the outlay can be obtained. The cost is estimated at £300,000. It is proposed that Cuba should subscribe £2,500 per annum, Trinidad, Surinam, Porto Rico, Demarara, Barbadoes, and Jamaica, £1,500 each, Martinique and Guadaloupe £1,000 a year each, and St. Thomas, Cayenne, and Santa Cruz £500 a year each.

FRANKING TELEGRAPH MESSAGES WITH STAMPS.—The application of stamps similar to those used for letters is now being tried at Berlin for telegraphic dispatches. The administration has for this purpose had stamps struck off at 8, 10, 12, and 15 silbergros. The person sending the dispatch sticks on the manuscript copy the number required to represent the sum stated in the tariff. In case of insufficiency, the clerk calls on the sender to pay the difference. The experiment is only at present being tried in one of the telegraphic offices of the Prussian capital, but if it succeeds the plan will be generally adopted throughout the kingdom.

ANGLO-INDIAN TELEGRAPH.—We have received intelligence from the disturbed district between Bagdad and Bussorah to the effect that the rebel Sheikh Mansuha had collected together some five or six thousand of the Montefic insurgents, and had attacked Fahad (the Sheikh nominated by the Turkish Government), whose force was supported by twelve hundred Turkish infantry and two guns. Mansuha was routed with great loss, and fled over to the other side of the Tigris. The country is now assuming a more settled state, and mounted messengers are being sent over the break between Diwanyeh and Bussorah every two days, occupying three and a half to four days in the journey. The line between Bussorah and Kurrachee works with the greatest possible celerity and efficiency, but it will be necessary to bring about a reorganization of the Constantinople and Bagdad land line, especially in stationing European signallers at the chief stations, before it can be properly worked for through traffic. Colonel Stewart is now on his way from Bombay to Constantinople to complete these and other essential arrangements.

THE RUSSO-AMERICAN TELEGRAPH.—The proposed Inter-Continental Telegraph, which, viâ Behring Straits, will complete the circuit of the world was recently the subject of discussion in the New York Chamber of Commerce. It appears that Russia has undertaken a line of 6,000 miles from Moscow to the Pacific Ocean at the mouth of the Amour, of which 4,000 miles from Moscow to Wkutsh are in operation, and that she has granted to Mr. P. M. Collins of New York a concession for thirty-three years, to extend this line up to and across Behring Straits, and then through her American territories to the frontier of the British possessions, a distance in all of 4,500 miles, that the British Government have granted a similar privilege down the northern frontier of the United States, and that an application is now pending in the Washington Congress for like permission through that country, thus connecting the whole telegraphic system of America. The Chamber unanimously resolved to memoralize the President and both Houses of Congress in favour of the undertaking. The full completion of the project may, it is alleged, be expected within three years. The total distance overland by way of Behring Straits, which are only 39 miles wide and 160 feet in depth, will be about 13,000 miles; and it is asserted that messages have been repeatedly sent during the present year from Boston to San Francisco, a distance of 3,000 miles in two minutes.

THE EGHAM RAILWAY ACCIDENT.—The jury, after a deliberation of nearly three hours and a half, returned a verdict of "Manslaughter against Thomas Lee, the driver, and John Trainer, the fireman of the Milo engine, attached to the second train, in having caused the deaths of William Winfield, Robert Wilkie, Edwin Halls, William Coppard, and Joseph Clegg; and the Jury consider that John Renshaw, the first guard, and John Dempsey, the second guard, laboured under great disadvantage owing to the mismanagement of the company—firstly, in not having a turn-table, thereby causing the trains to be sent out tender first, so that there was no use of the communicator; secondly, the want of telegraphic communication; and thirdly, the want of knowledge of the stopping of the trains, the first being at Egham and the second at Staines.

NEW SOUTH WALES.—The only telegraphic works at present in progress in this colony are three branch lines, which are being carried out under the arrangement with the residents in the various districts, that the Government shall receive £5 per cent. on the outlay. On the line from Braidwood to Queenbeyan, a length of thirteen miles have been cleared, the holes for the posts have been sunk for the distance of fifteen miles, the posts are all erected on the line from Deniliquin to Hay, and fifteen miles of wires are stretched. The line from Wellington to Dubbo has been commenced. The estimates for 1864 being at length passed, tenders will shortly be called for the new lines for which money has been voted. Those consist of extensions from Mudgee to Murrurundi, and from Braidwood to Arulen, and the extension of the line to Cooma.—*Herald.*

FISHING BY ELECTRIC LIGHT.—A first attempt was made to fish by electric light a short time since at Dunkirk. The light was supplied by a pile on Bunsen's principle, composed of about fifty elements, and it succeeded tolerably well, but the employment of the pile was attended with much inconvenience. It was then determined to repeat the attempt with a magneto-electric machine. The new experiments tried at Dunkirk and Ostend had a double object—first, to prove how the light produced by the machine would act under water; and second, to discover the effect the light would produce on the fish. The first object was completely accomplished, and it is now demonstrated that magneto-electric machines and the light they produce are applicable to all submarine works. In fact, this light was constant at 180 feet under water, and it extended over a large surface. The machine, nevertheless, was placed at a distance of more than 300 feet from the regulator of the electric light. The glass sides of the lantern remained perfectly transparent, and the quantity of coal consumed was less than if it were in the open air.

THE SPEZZIA AND CORSICA SUBMARINE CABLE.—The steamer Fanny Lambert, Captain Christopher, arrived at Malta on the 25th inst. from Genoa with Mr. John Temple, engineer; Mr. Henry Saunders, electrician to Messrs. Glass, Elliot, & Co.; and a staff of workmen, having been away for a month repairing the submarine telegraph cable between Spezzia and Sardinia and Cape Corso, in Corsica. As this is one of the very earliest deep-water cables, having been laid in 1854 in over 250 fathoms of water, and as it has worked without the slightest interruption up to the present time, some information as to its condition will be interesting. We understand that close to the shore, within half a mile, the cable was much chafed and worn on the Cape Corso (Corsica) side, but after that it proved to be in excellent condition for about twelve miles out, where, after passing over 90 fathoms depth of water, it suddenly shoaled to 60 fathoms, and the cable having the outer protecting wires completely chafed off it broke. The soundings showed that a reef of sharp rocks extended in a northerly direction. The cable was grappled outside of this reef in about 80 fathoms of water, about three miles nearer Spezzia than where it broke, and as signals were then good to Spezzia the cable was relaid to the Corsica shore again clear of the rocky reef, and communication re-established. The cable is what is termed a heavy cable, as it weighs ten tons to the mile, the protecting wires being twelve No. 1 wires, and although it has been laid ten years, the outer wires show a very slight deterioration, the decay and oxidization being hardly perceptible, excepting very near the shore. The gutta-percha insulating the copper conductor is in a perfect state of preservation, not having suffered in the least, and the hemp bed for the outer wires has the tar still fresh in it. Had the cable been originally laid clear of the reef, as it now is, it would not have suffered any interruption, and it is very encouraging to the cause of submarine telegraphy to know that the cables are so permanent and durable as this cable has proved.

TELEGRAPHIC SCHEMES.—Mr. Secretary Seward, being called upon to state to a committee of the Senate his views upon Mr. Collins's project for a telegraphic line connecting the Russian systems of telegraphs with those of America, reports that throughout that gentleman's negotiations with the Russian and British Governments for leave to pass through their American possessions he has been acting under the instructions of the American Government, and that his application to Congress for a right of way across the public lands and the use of a national vessel is reasonable. Mr. Seward proceeds to say that the line which the Russian Government is constructing, or has undertaken to construct, from St. Petersburg to the mouth of the Amoor, is but a small part of the stupendous work which the Emperor has begun. His Imperial Majesty's design embraces also a telegraphic wire from the mouth of the Amoor, over the islands of Sakhaliu and Jerro to Jeddo; also, from the Amoor, along the banks of the Usuri, to Viadi Vostok on the coast of Tartary, Viadi Vostok being selected by the Emperor for his naval station on the Pacific coast; also a wire from the Irkoutsk telegraphic line, though the vast territory of the Mongols to Pekin; and American citizens in China are soliciting, with good prospect of success, permission from the Chinese Government to extend this line to Nankin, Shanghai, Amoy, and Canton. Further, the Russian scheme comprises a telegraphic wire from the main Continental-Russian line at Omsk, near the southern boundary of Asiatic Russia, through Mongolia, China, Turkestan, Bokhara, and Cabool, to meet the telegraphic system of India in the Punjaub, and connect it with Europe; and also a wire from Kazan on the main central Russian line, passing along the shore of the Caspian Sea to Teheran and along the banks of the Euphrates to the Persian Gulf, there to be connected with the telegraph system of India. Mr. Seward, however, confines his remarks chiefly to the line immediately in question, connecting America with Russia through Behring's Straits. He submits to the Senate that it is impossible to over-estimate the direct effect of such works in the development of the resources of the American States, or to assign limits to the increase of national influence which must result from such new facilities for extending throughout the world American ideas and principles of public and private economy, politics, morals, philosophy, and religion. The telegraphic wire is at present, he says, timidly employed and clumsily handled, with a very imperfect knowledge of the fulness of the power which resides in it; he anticipates that telegraphic communication will become far more practically effective. He trusts that an Atlantic line will soon connect Cape Clear and Cape Race, thus completing with the proposed line through Russia a telegraphic circuit round the earth between 42 and 65 degrees north latitude; but he holds it to be certain that the great interest of society will at a very early period require more than one, and more than even two trans-oceanic world-encircling telegraphs.

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.—EXPERIMENTS ON THE PNEUMATIC SYSTEM.—On Wednesday, the 22nd ult., several important experiments in telegraphy were made with an apparatus constructed on the pneumatic system at the offices of the Electric and International Telegraph Company in Castle-street. A number of influential gentlemen were present, and the proceedings were watched with much interest. The visitors were conducted through the different rooms of the establishment by Mr. Whittingham, the manager to the company, and the mode in which it was proposed to work the apparatus was lucidly explained by Mr. C. F. Varley, the inventor. Owing to the increase of telegraph business at the various stations of the company in Liverpool, and their central station in Castle-street, they resolved upon connecting them by means of an apparatus known as the pneumatic system. On the basement of the building in Castle-street an engine of about one-horse power has been fixed, working an exhaust air-pump, and also a compressed air cylinder. These two pumps during the busier hours of the day are continually forcing air into the vessel called the compressed air chamber, while the other is continually exhausting a similar chamber known as the vacuum cylinder. The dimensions of these two reservoirs of power are 4 feet in diameter and 10 feet in length. There are valves attached to the chambers, by which means the vacuum reaches 20-inch air, but is limited to that amount. The compressed air valve is weighted to blow off at 11 lbs. The two chambers are connected with the instrument-room on the first floor by means of lead pipes two inches in diameter. In this room there are two valves of novel construction, which are destined for sending or receiving messages to or from the company's stations at the Royal Exchange or in Water-street. Electricity performs a subordinate part in this operation, and by its aid bells are rung at the different stations, and the necessary signals connected in a moment for the transmission of the messages. On the Royal Exchange officials wishing to send a message to Castle-street, the clerk rings the bell once, when another clerk in Castle-street, by simply pressing down a little button connected with the exhausted chamber, sets in operation the whole of the apparatus necessary for transmitting the message. The first action is to close up the valve; the second to open a communication between the pneumatic pipe which reaches from the Royal Exchange to the exhaust chamber in Castle-street. The pressure of air being thus taken from the tube, the air rushes in at the Royal Exchange end, and carries the little piston containing the message through the pipe to Castle-street. On its arrival at Castle-street, by a simple self-acting contrivance the communication between the exhaust chamber and the pneumatic pipe is severed, the vacuum destroyed, and the valve opened, when the carrier falls on to a counter prepared to receive it. The distance between these stations is about 300 yards, and the time occupied by the little piston containing the message coming through was found by experiment to be 16 seconds—the rough estimate of time being about 40 miles an hour. The whole of the apparatus is self-acting, and the moment the signal is given the clerk in attendance has but to touch a button, when the compressed air or the vacuum is made to open or close on the necessary valves, and to transmit the despatch. To send the message back from Castle-street to the Exchange or Water-street buildings the compressed air chamber is brought into requisition. The message is first of all put into the pipe, and by pressing a button labelled "send," the compressed air is made by the self-acting apparatus, first of all, to close the end of the tube, and, having closed it, to open a communication between the large compressed air chamber and the pneumatic pipe, when the carrier containing the message is blown to its destination. The moment it arrives the clerk gives two strokes to the electric bell, and the clerk in attendance at the Castle-street station immediately presses a third button

labelled "receive," when the vacuum chamber is once more called into requisition, and cuts off all communication between the pipe and the air chamber. In a short time, however, this operation by the clerk will be dispensed with, as it is intended to make electricity perform it, and the apparatus will then be entirely self-acting. We may state that the pneumatic pipes have been worked by the Electric Telegraph Company in London for the last ten years, and that the messages have invariably been conveyed by atmospheric pressure—that is to say, by a vacuum. Two tubes were necessary in order to send messages through the pipe in opposite directions—the one to convey the messages, the second to convey the vacuum or force to the distant station for taking them back again. In the apparatus, however, in Castle-street, compressed air is used for the purpose of sending the messages back, so as to obviate the conveying of vacuum to the second pipe to a distant station; greater speed and certainty are, too, obtained in the delivery of the message, as the air has to travel a shorter distance—that is, through one tube—and any amount of pressure may be obtained by means of compressed air. In the present case 11lbs. per inch pressure is used, but greater distances would be reached by a higher pressure, were such necessary. The present pipes are 1½ inch in diameter, and three-quarters of a mile in length, and the period occupied in sending a message through these distances varies from 70 to 90 seconds. The new system of telegraphy is being extended all over London by the Pneumatic Despatch Company, who are laying down pipes 4 feet 6 inches in diameter, so as to carry the mails between the Post-office and the Euston terminus. The great advantage of the new system is that it enables the Electric Telegraph Company to cope with the increasing traffic, to perform the service more expeditiously and more cheaply, and lastly, to avoid the errors hitherto consequent upon the transmission of messages between the central and out stations. The apparatus altogether is remarkable for its ingenious and practical character, and worthy of its able inventor, Mr. C. F. Varley. The experiments made on Wednesday were eminently successful. In the evening the following gentlemen dined together at the Adelphi Hotel:—Mr. Cromwell F. Varley, electrician and engineer of the Electric Telegraph Company, in the chair; Mr. Barber, chairman of the Great Eastern Ship Company; Mr. Boult, Mr. Whittingham, local manager of the Electric Telegraph Company; Mr. Thomas Court, Mr. L. H. Parr, Mr. George Newman, Mr. J. Muirhead (of London), &c. The cloth having been removed, the loyal toasts were given, and the chairman, in proposing "The Health of Mr. Barber," delivered a most interesting address, in the course of which he referred to the great influence which science had had in civilising tribes of mankind who had hitherto lived in a savage state. The discoveries of science had enabled steam to be produced from coal, and from this had followed steam navigation and railway communication. The application of electricity to the transmission of telegraphic messages had not been less important. It was an interesting fact that the great telegraphic system in the British possessions in India was about to be connected with the enormous telegraphic system of Europe through Teheran, the capital of Persia, and the wilds of Siberia. The whole of the Indian communication would ultimately pass through Turkey, viâ Bagdad, but at present there was a link wanting in the chain, owing to the hostility of the tribes between Bagdad and Bussorah, who had frequently destroyed the telegraph. Since English officers had commenced negotiations there was every probability of the confidence so unfortunately forfeited by the Turkish authorities being restored, and an early completion of the line was anticipated. The Russian Government had already extended her telegraph as far as Irkoutsk, in Siberia, on the frontier of China, and at no very distant date they might anticipate that America would be connected with Europe through those channels. But prior to that date there was every reason to hope that the direct Atlantic route between Newfoundland and Valentia would be successfully established. As an instance of what might be anticipated in future, the following would enable an idea to be formed: By the automatic relays, established all over the European system of telegraphic communication, the various lines were linked together; a fresh power was automatically picked up at various transmitting stations, and direct communication was established between these points, distant 6,000 miles, without the intervention of any human transmission. On the completion of a message from Irkoutsk to London, the answer was commenced in London within three seconds of the completion of the message to London. On a recent occasion the director-general of telegraphs in Russia, General Guerbard, sent to him (the chairman) a message on a Sunday morning from Irkoutsk, which was handed the same day to Mr. Cyrus Field, on board the Persia, at Queenstown. This message was published in San Francisco in ten days and a-half from the date when it left Irkoutsk, of which nine days and a-half were occupied in carrying the message from Queenstown to New York. The total distance over which the message was transmitted was about 9,000 miles, 7,000 of which occupied but twenty-four hours. Thirty years ago any person who had ventured to say that a message would be sent from London to Liverpool in five minutes would have been looked upon as a madman; and yet, in much less time, the frontier of China was able to communicate with any station in Europe. Even in the uncivilised country of Persia the telegraph had extended itself; and it was a most significant fact that the great English system in India would, within a very few days, be in communication with that enormous European system of telegraph through the hitherto supposed uncivilised country of Persia, and the scarcely known regions of Siberia. It was also a remarkable fact that one of the most successful telegraphic systems was that between New York and San Francisco. It was carried through savage Indian territory, and across snow-capped mountains which had hitherto been considered almost inaccessible. The time occupied in carrying a mail from California to New York was six days, and so important was this communication that the projectors were remunerated during the first year by a dividend of ninety-six per cent. It was not uncommon for the news which appeared in the New York journals to re-appear on the same day (owing to the difference in latitude) in the San Francisco journals. Recent events had shown the importance of direct communication between England and America. Already the telegraph extended from New York to Newfoundland, and from London to Valentia, and the only link not completed was that of 1,640 miles. When this was completed there would be uninterrupted communication between California and Mexico in the west, and Irkoutsk in the far east. The Great Eastern was the only ship capable of laying the cable to complete this important chain. It had afforded him (the chairman) great and unexpected pleasure to meet with Mr. Barber, the representative of the ship, and he thought it right to mention the advantageous terms upon which that ship had been lent for this enterprise. Her profits were entirely identified with the success of the undertaking. The chairman concluded by proposing, "Success to the Atlantic Cable and the Great Eastern Steamship, coupling with the toast the name of Mr. Barber." The toast was heartily received. Mr. Barber, in responding, observed that he trusted that the enterprise in contemplation would enable the Great Eastern to prove a scientific success, though hitherto she had not been a commercial one. The terms of the present engagement were highly satisfactory, and he believed the time was not far distant when the anticipations formed of the great ship would be realised. Several other toasts were proposed, and allusion was made by subsequent speakers to the fact that Liverpool was the only town in the kingdom, besides London, in which the Pneumatic Company had gone to the expense of introducing the pneumatic system. "The Healths of Mr. Newman and Mr. Whittingham" were proposed and responded to, and the proceedings shortly afterwards terminated.—[We quote the above from the *Liverpool Daily Post*, and do not hold ourselves responsible for the statements contained therein.—ED. *T. J.*]

MISCELLANEA.

QUICK WORK.—The Siberian telegraph line is working to Queenstown, Ireland, from Irkoutsk, Siberia, a distance of 6,500 miles. A despatch was transmitted the whole distance in two hours, a great feat, making a fair allowance for gain in apparent time.

SLEEP.—Women require more sleep than men, and farmers less than those engaged in any other occupation. Editors, reporters, printers, and telegraph operators need no sleep at all. Lawyers can sleep as much as they choose—it will keep them out of mischief.

THE TELEGRAPH AND THE PRESS.—I proceeded to a suite of rooms occupied by the sub-editor and the principal reporters. In the outermost of these rooms is arranged the electric telegraph apparatus—three round discs with finger-stops sticking out from them like concertina keys, and a needle pointing to alphabetic letters on the surface of the dial. One of these dials corresponds with the House of Commons, another with Mr. Reuter's telegraph-office, the third with the private residence of the conductor of my journal, who is thus made acquainted with any important news which may transpire before he arrives at, or after he leaves, the office. The electric telegraph—an enormous boon to all newspaper men—is specially beneficial to the sub-editor; by its aid he can place before the expectant leader writer the summary of the great speech in a debate, or the momentous telegram which is to furnish the theme for triumphant jubilee or virtuous indignation; by its aid he can "make up" the paper—that is, see exactly how much composed matter will have to be left "standing over," for the tinkling of the bell announces a message from the head of the reporting staff in the House to the effect, "House up—half a col. to come." Sometimes—very rarely—wires get crossed, or otherwise out of gear, and strange messages relating to misdelivered firkins of butter, or marital excuses for not coming home to dinner, arrive at the office of my journal. The sub-editor has a story how, after having twice given the signal to a West-end office which Mr. Reuter then had, he received a pathetic remonstrance from some evidently recently-awakened maiden, "Please not to ring again till I slip on my gown!" On the sub-editor's table lie the weapons of his order—a gigantic pair of scissors, with which he is rapidly extracting the pith from the pile of "flimsy" copy supplied by the aid of the manifold writer and tissue paper by those inferior reporters known as penny-a-liners, and a pot of gum, with which he fits the disjointed bits together; here also are proofs innumerable in long slips; red, blue, and yellow envelopes, with the name of my journal printed on them in large letters—envelopes which have contained the lucubrations of the foreign and provincial correspondents; an inkstand large enough to bathe in; a red chalk pencil like the bowsprit of a ship; and two or three villainous-looking pens. At another table, a gentleman gorgeous in white waistcoat and cutaway coat is writing an account of a fancy fair at which he has been present; printers, messengers, boys, keep rushing in, asking questions and delivering messages, but they disturb neither of the occupants of the room. The fancy fair gentleman never raises his eyes from his paper, while amid all the cross-questioning to which he is subjected, the sub-editor's scissors still snip calmly on.—*All the Year Round.*

Iron becoming Hot by Stretching.—In a recent discussion on testing chain cables, Mr. Gladstone stated that he had had great experience in the matter, and had observed that when the iron begins to stretch the temperature rises, becoming so hot before the link parts, that the hand when brought in contact with it cannot bear the heat.

Temperatures at which Metals Boil.—These have been hitherto determined by means of an air pyrometer, but M. Becquerel has adopted another method for their determination. The instrument he employs is a thermo-electric pile, and with it he found that the following metals boil at the following degrees Fahrenheit:—Cadmium, 1,328; zinc, 1,688; silver, 1,681; gold, 1,879; palladium, 2,517; platinum, 2,690. It is of some importance to state that certain of these figures are lower than those obtained by M. Becquerel, when using the air pyrometer.

How to Work.—Cheerfulness gives elasticity to the spirit. Spectres fly before it; difficulties cause no despair, for they are encountered with hope, and the mind acquires that happy disposition to improve opportunities which rarely fails of success. The fervent spirit is always a healthy and happy spirit, working cheerfully itself, and stimulating others to work. It confers a dignity in even the most ordinary occupations. The most effective work, also, is always the full-hearted work—that which passes through the hands or the head of him whose heart is glad. Hume was accustomed to say that he would rather possess a cheerful disposition, inclined always to look at the bright side of things, than with a gloomy mind to be master of an estate of ten thousand a year.

A Yankee "Notion."—The following humourous lines appear in a New Year's Address of the carrier of the *Scientific American*. Our friends across the water have either very inadequate powers of discrimination between *meum* and *tuum*, or they have allowed their Muse unlimited scope in the region of fancy. Poets are generally permitted to deviate from exactitude, where no vital consequences are involved; but the carrier of our trans-Atlantic contemporary, in this instance, has made sad havoc of facts:—

"Now, how shall I, the humblest of all men,
Describe the telegraph with my poor pen?
My 'lines' are not of wire, but lines of ink;
Yet, if you should *ink-wire* who made that link
Which joins the earth's most opposite extremes,
Annihilating time and space, it seems
One answer only I could give. 'Tis plain
That Samuel Finley Breese Morse did attain
Perfection in the telegraphic art;
Making men's words, like lightning's flashes, dart
A thousand miles within a moment's space;
Uniting nations—joining race with race!
Through the dark storm-cloud good old Franklin saw
A glimpse of God's great skyward-written law!
By simple means—a kite and string and key—
He proved that lightning hath identity
With the electric fluid, which, it seems,
He drew from sky to earth in brilliant streams.
By electricity—that wondrous fire—
The mind of man is made to run on wire!
Mind, unlike matter, cannot be defined.
Would you know what is *matter?* Never *mind!*
Morse built in year 'eighteen and forty-four,'
Straight between Washington and Baltimore,
A 'line'—the first in the United States—
And did much business, spite of heavy rates,
When through deep rivers Morse found he could talk,
A short aquatic line quite near New York
His hands constructed; this was a success,
Although a small affair; but yet, I guess,
In Morse's eye a 'cable' submarine,
Beneath the great Atlantic was then seen.
'Oh!' cries some saucy youth, 'I'd like to spy
The man who had a cable *in his eye!*'
Years afterwards occurred a great event:
A British Queen and Yankee President
Congratulations sent beneath the sea;
But Neptune would not with the 'wire' agree.
Said he: 'This telegraphic talk I ban!
No President 'or any other man'
Shall flirt with females *under water*. Hence
He cut the 'cable,' but we can't dispense
With such a 'bond of brotherhood.' I hope
That ('if it please the pigs' or 'teaze the Pope')
Before next New Year's Day, we shall be tied
To England by a wire, just like a bride
And bridegroom by a ring. That magic charm
Shall guard both nations from each other's harm.
But not alone to Morse we look for news;
There's Bain and House, and (later still) there's Hughes.
Each of these telegraph inventors can
Claim praise for ingenuity. The man,
However, whom Fame doth the most indorse—
The people's favourite messenger—is Morse."

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1538. W. J. Pughsley, improvements in obtaining sulphuric acid from the refuse "pickle" used in tin-plate works, and also from sulphate of iron or green copperas.
1565. J. D. Adams, improvements in electrical communicators.
1577. Improved machinery or apparatus for vulcanizing india-rubber, which machinery or apparatus is peculiarly adapted for vulcanizing by the cold process or without the application of heat.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

680. W. A. von Kanig, improvements in railway telegraphs and signals, and also in the permanent way and carriages for preventing railway accidents.
1386. W. Clark, improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power.—A communication.
1412. H. A. Bonneville, improvements in telegraphic printing apparatus.
1458. J. McElroy, improvements in electro-telegraphic apparatus, and in instruments for preparing the transmission of electric telegrams.

NOTICES TO PROCEED.

454. E. A. Cotelle, an apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general.

PATENTS SEALED.

833. W. E. Newton, improvements in electric or telegraphic conductors.—A communication.

PATENTS WHICH HAVE BECOME VOID.

1503. J. A. Callaud, improvements in the construction of electrical piles.
1512. R. Jobson and C. F. Varley, improvements in posts or supports for telegraph wires.
1567. W. E. Newton, improvements in electro-magnetic engines.

PATENTS ON WHICH THE STAMP DUTY OF ONE HUNDRED POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1830. W. Pole, improved means for supporting telegraph wires.—30th June, 1857.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6	per lb.

India Rubber.

Para, first quality	1/9 to 1/10	,,
second ,,	1/6 to 1/7	,,
third Negro-head	1/2 to —	,,
Java and Penang	1/4 to 1/5	,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	102 to 105	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	⅜ to ⅞	—
5	United Kingdom Telegraph .	3	1½ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	2½ to 3½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	¾ to ¼ dis.	—

TO CORRESPONDENTS.

Investigator.—The galvano-meter employed consisted of 30·500 coils of wire, $\frac{1}{570}$ of an inch in diameter, most efficiently covered with silk by Mr. Campion. The needles (not astatic) were suspended by an unspun silk thread. The remaining parts were constructed by Mr. Izant.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance in our efforts to establish a Journal worthy in all respects of the great interest it seeks to represent, by furnishing us with brief notices of events and occurrences in connection with Telegraphy.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

	s.	d.
Quarterly	4	4
Half-yearly	8	8
Yearly	17	4

THE TELEGRAPHIC JOURNAL.

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AN INSURANCE COMPANY'S PROTEST AGAINST ELECTRICAL OPERATIONS.

"MOVE ON" is a recommendation that might be given to others than itinerant vendors of edibles. We know of people who are sadly behind the age. They have not yet realized the advantages of the railway system, and prefer the light of a "dip" to gas illumination. If they have adopted any improvements effected by human ingenuity since their childhood it has been owing to external pressure or from sheer necessity. They are constrained to advance, but it is always slowly, and in the rear of their contemporaries. In business relations it should be otherwise. We commend the exercise of caution in commercial transactions, but most strenuously protest against a spirit of obstructiveness manifested occasionally in spheres where we had hoped to find a disposition to encourage the arts, sciences, and manufactures. In these days of cheap literature, when every possible means have been employed to raise the standard of middle class education, and to popularise science, no palliation can be offered for an offence against the teachings and experience of the *savans* of Europe by the directory of an association depending in a great measure upon the patronage of the public.

It will be within the recollection of our readers that on the 11th ultimo a *soirée*, in connection with the Royal Astronomical Society, was held at Willis's Rooms, under the able presidency of Mr. Warren De la Rue. Concerning this meeting an almost incredible story is narrated in a contemporary, which shows the petty annoyances to which men of science are subjected at the hands of others, whose social status would lead us to expect better things from them. Mr. De la Rue says:—

"On Friday, the 10th June, during the preparation of Willis's Rooms for the reception on the following day, the proprietors informed me that they could not permit electrical experiments, as their insurance office had given them notice that the Company would not hold themselves liable for damage by fire during the continuance of electrical apparatus in the building. Not wishing to forego the exhibition of experiments for which extensive preparations had been made, I called on Saturday, the 11th, on the secretary of the office, who received me very courteously, and listened patiently to my explanation, but declined to remove the veto which had been issued or to grant a special insurance, for which I would have paid. Under these circumstances I addressed myself to the Sun Insurance Office, where I had already insured the articles entrusted to me for exhibition, and effected an insurance for £20,000 on the buildings and contents. Although the expense was not considerable, I was put to much personal inconvenience at a time I could ill be spared from the superintendence of the arrangements."

We are not surprised at the course pursued by the proprietors of Willis's Rooms—most men of business would have acted likewise in a similar situation; but we confess to no small degree of astonishment that the Royal Exchange Fire Insurance Company should repudiate its liability without giving good and sufficient reason for such a proceeding. It would be interesting to know the precise objections entertained by this Company to electrical apparatus. Many persons unacquainted with the interests we represent would be led to suppose, from the determination of the Company not to remove the veto on remonstrance, or to issue a special policy of insurance on a very equitable condition, that electrical operations are generally attended with disastrous results; but this supposition we know to be unfounded. There is not even a tradition of importance current in insurance circles relative to danger to be apprehended from this class of risks, for most of the buildings in which our great telegraph works are carried on are insured at ordinary rates. The circumstance that the multiplication of electrical apparatus at the top of house property in London and other large towns averts destructive catastrophes from lightning appears to have escaped the attention of the sapient Board of Directors. The presence of "batteries," the emission of "sparks," the glare of an intense "light," the "combustion" of charcoal points, and the possibility of metal being "fused" by electricity in one building must have been "shocking" in contemplation! The experiments proposed were not of a dangerous character. It was not intended to raze the walls of the building with a torpedo, but simply to exhibit the electric light. Had the Directors visited the Royal Institution, or any chemist's laboratory, they would have found far more terrible instruments in full operation than those placed on view in Willis's Rooms "for one night only;" and had they satisfied themselves that additional risks were being incurred on this occasion, and demanded a proportional premium, we should have been spared the painful duty of adverting to their folly and obstinacy. It is a difficult matter to deal with Boards; as one of our satirists has remarked, "they have neither souls to be saved nor bodies to be kicked." The managers of large commercial undertakings are generally shrewd men, well posted in the details of the business in which they engage. Not so in the case under consideration. The Directors of the Royal Exchange Fire Insurance Company appear to be unable to discriminate between cause and effect—between an instrument to be employed and the result to be attained by its operation. Their liability was repudiated not on account of approximate danger, but in consequence of the existence of electrical apparatus in the building insured in their office. The absurdity of the objection hardly merits serious consideration. It is frivolous and vexatious in the extreme, and "fit only for a 'point' in the wildest pantomime."

INDIA-RUBBER COVERED CABLES.

IT will be remembered that Sir W. O'Shaughnessy ordered for the Indian Government a length of twenty miles of copper-wire, coated with india-rubber by Messrs. Hall & Wells, and sheathed by Mr. Henley with an outer covering of galvanised iron wires. The conductor was a strand of seven wires, weighing 270 lbs., the caoutchouc weighing from 165 lbs. to 170 lbs. per statute mile.

This cable has been erroneously referred to as being used in the Persian Gulf. It was intended to cross an inlet upon the Mekran coast, forming part of the Guadur and Kurrachee line, but the line was completed, by means of an overground telegraph, before the cable arrived, and it was consequently coiled, under cover, in the hold of the Hyderabad flat, in Kurrachee harbour.

On the arrival of Colonel Stewart, at Kurrachee, in the Coromandel, on the 25th January last, it was determined to send five miles of it to Mussendom, to be used in a separate circuit, in order to test its utility, and it was accordingly sent there, and coiled under water in Elphinstone's Inlet.

When the station was removed from the mainland to Elphin-

stone Island it was decided to employ part of it in uniting the island to the mainland. On testing it, however, it was found defective, the caoutchouc showing signs of tackiness. After cutting it into four sections, all but one of which were very faulty, a length of thirteen hundred yards was picked out with sufficiently good insulation for use. This was laid from the Clyde gunboat, on the 29th February, between the land and the newly-established station on the island. After working for a short time the insulation began to fail rapidly, and on the 14th March it was found necessary to lay a length of the regular Persian Gulf cable to supply its place. On the 16th the caoutchouc-covered cable was taken up, to examine into the cause of failure, when the insulator was found to have become very soft, and, on exposure to the air, became of the consistence of treacle; very similar, in fact, to the state of the length of rubber-covered cable laid from Manora Point, near Kurrachee, in 1860, which was picked up and examined by Mr. Latimer Clark, in 1862.

It would appear that something is still wanting in caoutchouc-covered cables, to ensure their permanency. This is much to be regretted, for, could the quality be attained, the high insulating property of the material, and its low inductive capacity, would doubtless lead to a very extended use of india-rubber in submarine telegraphy.

FORCE AND FORM.

CONTRIBUTED BY BLANCO MOUGREVE.

FORMERLY scientific men, in writing of matter, divided it into two sorts, ponderable and imponderable. The imponderables were heat, light, electricity, and magnetism. They have now come to consider these imponderables as force, and not matter. I wonder what the essential properties of matter are? We have seen a great deal that has been written, and heard a great deal that has been said on this subject. It may have been to good purpose, or it may not. Also we have heard a great deal said against all such vain speculations, a bottling up of moonshine —by the way, cannot moonshine be bottled up? I believe it can; though moonshine is not matter, *selon nos savants*. But would it not be a desirable thing to know what we mean when we say *matter?* doubtless, and also what we mean when we say force—I beg pardon, *energy?* that is the fashionable word as I believe: but habit is so strong with me.

It does not appear to me that it would be a very difficult task to separate the accidental from the necessary properties of all those that we know of both matter and force: let us try. Matter first. To the sight: colour and shape. Colour is not essential, for matter may be colourless. Shape is infinite, regular, or irregular, and matter must of necessity have some shape; seeing that matter is infinite and must be bounded by surfaces; but the general expression of shape is form; therefore form is essential.

To the touch: hard, soft, or unyielding and yielding, elastic, nonelastic, rough, smooth, and hot and cold, also shape or form, and, together with all these, resistance. Of these, form and resistance are the only generals, for each of the others can be dispensed with in turn, but these never. Therefore, form again is essential, and to it is added resistance.

To the smell: there can be no smelling without effluvia; but what is effluvia. Philosophers say they are the finest and most volatile parts of matter, and though they cannot be perceived by sight or touch, yet reason shows that without form and resistance they are not even conceivable. But has all matter scent? Our experience says no, and our smell is no further concerned; but whether all matter has effluvia, or which is the same thing, has a sphere of volatile particles, is another affair, and does not touch us here.

To the taste: some forms of matter are said to be tasteless; therefore taste is not essential.

To the hearing: hearing is the effect of the tremor, or gyration of the air; therefore is some form of the motion of matter, and from it no essential property of matter is perceived, or derivable.

Of all the properties of matter perceivable by our senses, form and resistance, it appears by this induction, are the only essentials; that is, matter is a somewhat which is cognizable to our senses as a form having resistance. Form is the bounding surfaces of a thing, which circumscribes it and separates it from every other thing: and resistance, what is it? It appears to be that power, which prevents matter being torn to pieces, and also prevents its compression beyond a certain limit. The one is called attraction, the other repulsion; but these are two manifestations of force or energy.

What then do we mean by matter? A form which is maintained such by an inherent force or energy, or simply force in a form. Now, I think, we have fairly come at this conclusion. However, if experience teaches anything to the contrary thereof, those who have such experience are hereby desired to declare it.

But is not that a wild conclusion? Still we take our senses with us, do we not? and in fact, do not take a step without their sanction. They may deceive us? Possibly. But everybody's senses will not deceive everybody at the same time; therefore the few in error can be corrected by the many not in error. True we cannot back up our conclusion by a host of authorities; but we can bring three that stand for something, and two of them at least I know to be common-sense matter-of-fact men, who have seldom soared into the regions of imagination: they are Swedenborg, Boscovich, and Faraday.

The first was a mystic, was he? Well, you say that because you know nothing of him. Ask Charles the Twelfth, and he will tell you, that he was his right hand of science; he took his ships across fourteen miles of dry land, he built him docks, he smelted him iron, he discovered for him and the whole world a new method of calculating longitude, which is partially in use still, after more than a century, and he alone has given the true theory of the magnet; I would not attempt even barely to name what he did for the arts and for science. And the last-named—there is no need to say anything of him; he is amongst us, and we all know him.

This is his reasoning on the subject; first having referred to the generally-received notion of an atom, as a little unchangeable, impenetrable piece of matter, with an atmosphere of force grouped around it:—"If the view of the constitution of matter already referred to be assumed to be correct, and I may be allowed to speak of the particles of matter and of the spaces between them as two different things, then space must be taken as the only continuous part; for the particles are considered as separated by spaces from each other. Space will permeate all masses of matter in every direction, like a net, except that in place of meshes it will form cells, isolating each atom from its neighbours, and itself only being continuous. Then take the case of a piece of shellac, a non-conductor, and it would appear at once, from such a view of its atomic constitution, that space is an insulator, for if it were a conductor the shellac would not insulate, whatever might be the relation as to conducting power of its material atoms; the space would be like a fine metallic web penetrating it in every direction. . .

"Next take the case of a metal platinum or potassium constituted according to the atomic theory in the same manner:— The metal is a conductor; but how can this be except space be a conductor, for it is the only continuous part of the metal, and the atoms not only do not touch (by the theory) but, as we shall see presently, must be assumed to be a considerable way apart. Space therefore must be a conductor. . . . . . .

But if space be a conductor, how then can shellac, sulphur,

&c., insulate? For space permeates them in every direction. Or if space be an insulator, how can a metal or other similar body conduct?

". . . . . . . Any ground of reasoning which tends to such conclusions as these, must in itself be false. If we must assume at all, as indeed in a branch of knowledge like the present we can hardly help it, then the safest course appears to be to assume as little as possible, and in that respect the atoms of Boscovich* appear to me to have a great advantage over the usual notion. His atoms, if I understand them aright, are mere centres of force or powers, not particles of matter, in which the powers themselves reside. If in the ordinary view of atoms, we call them particles of matter, away from the powers, *a*, and the system of powers or forces in and around it, *m*, then in Boscovich's theory *a* dissolves or is a mere mathematical point. . . . .†"

Referring to the differences between Boscovich's, and the ordinary theories, he says:—"With the latter, atoms is a mass of matter consisting of atoms and intervening space; with the former atoms, matter is everywhere present, and there is no intervening spaces unoccupied by it. . . . . Hence matter will be continuous throughout." But we refer the reader to the *Philosophical Magazine*, for his reasonings in full.

Now let us strive to ascertain what we mean precisely by the word force or energy.

To our senses there is but matter and its changes. We have seen what properties are essential to the existence of matter, to our senses, and within these is included force, as essential to matter; but though any mass of matter must have within it an inherent force, it may also have force acting upon it from without. This is accidental; but it is a manifestation of force, and to the senses is simply change of place or state.

To the sight. It is motion, or change of colour or form, that is change of place or state.

To the touch. Change of form, or of surface, or of temperature, or consistency: as from solid to liquid.

To the smell. Change of scents, or change of degrees of the same scent.

To the taste. The same as to flavours.

To the hearing. Change of sounds as to quality, or as to degrees.

Therefore as to force, *change* is the only essential which is perceivable by our senses, and force is a necessary inference of the intellect, as a power that produces change, seeing that no change can be conceived to produce itself, no, not even if it were a *thing*, for that would be supposing it to exist before it did exist, so that it might exist. This force then is that inscrutable life which runs through all things, from stones and earth through plants, animals, and man, whereof form is the body. Yes, life of even stones and dirt! The power to be and to do. Can anything exist without it? Take the lowest form. Can anything exist without attraction of cohesion? A quasi-passive force, whereof the active is chemical affinity, from which we mount to organic, or vegetative, thence to animal, and finally to man, and to each by insensible gradations; but this is a wide subject and leads away from our present enquiry. It is well then to know what we mean by matter and force; but it is a pleonasm to talk of matter and force as two distinct things; matter is *force and form*, and force can only be spoken of as an abstraction, just as in geometry we speak of a point, a line, a surface, when nothing but solids exist or are possible. But force is higher than form; form being only its ultimate manifestation. Force in a form then is matter, and each apart is nothing; but for the convenience of our thinkings we can mentally separate them.

Of forms it is necessary here to consider the most crude or mechanical only, and of forces those which pertain to them, this being but a slight indicatory sketch of the course to be pursued in any thorough enquiry after the different forms of force or energy, and their convertibility, or whether they can be one converted into another, or merely induced one by another, which is what is called "conservation of force," which expression seems to me just a truism, when one has affirmed that matter is indestructible.

* Swedenborg developed this theory before Boscovich.

† Phil. Mag., 3rd Series, vol. 24, pp. 137, &c.

TELEGRAPH ROUND THE WORLD.

THOUGH the recent able communication of Secretary Seward upon the subject of an inter-continental telegraph via Behring's Straits contains not even a distant allusion to Professor Morse, it must still be gratifying to the venerable electrician to find that the experiment of laying a little line of wire forty miles in length, with a recording machine at the end of it, which he constructed between Washington and Baltimore as long ago as the year 1844, has grown into a vast system, promising so soon to embrace the globe in its operations. For it is a singular fact that, with all the variations in form, the "Morse system," in its essential features, is retained the world over. Then, in regard to submarine lines. Professor Morse's successful experiment in the year 1842, with submerged wires between Castle Garden and Governor's Island (which secured the golden medal of the American Institute), gave the first substantial proof of the practicability of this method of electric communication. It is also proper to observe in this connection that the very next year the project of an Atlantic telegraph was laid down, and its success predicted in a letter to the Secretary of the Treasury, in which Professor Morse said, "Startling as this may now seem, the project will be eventually consummated." Twenty years later, as appears from Mr. Seward's letter just written, energetic minds in England and America have resolved to combine their capital to link the two hemispheres in a single telegraphic circuit.

Two projects are distinctly in mind, besides others less prominent, one looking to a connection westward and the other across the Atlantic; but they can in no sense be considered rivals. As we survey the world at large the telegraphic system represents two sets of meshes, each growing more and more intricate every year, yet completely separated one from the other. The intelligence conveyed by them respectively is vast in amount, and much of it possessing a value which would be enhanced many fold, were there provided a medium for exchange. No single line would be adequate to the demand made upon it, either in Europe or the United States. Mr. Seward's letter examines carefully the merits of the line proposed by P. McD. Collins, who has spent several years in obtaining concessions from Russia and England for the extension of a line via Behring's Straits and Siberia, to connect with the Russian telegraph now completed as far east as Irkoutsk, from St. Petersburg. The extent of the route, we are informed, is not an insurmountable difficulty, as the entire length would be about 6,040 miles, divided as follows:—

In the North-western Territories	1,000	miles.
In British America	600	„
In Russian America	1,900	„
Across Behring's Straits	40	„
To the Amoor River	2,500	„
Total	6,040	„

Lines have been already stretched over steppes in both continents similar to those now proposed. There is no lack of timber. The temperature of the region to be traversed is no more severe than in other remote parts where communication is maintained without difficulty. Indian tribes are so well subject to the restraints of civilization that their resistance is not expected. The expense involved is estimated at $5,000,000, though an association has been formed with a capital of double this amount, and as the co-operation of other Governments is secured already, Mr. Collins only desires that Congress shall grant a right of way across the public lands, with the right to take therefrom materials necessary for constructing the line; the use of a national vessel, suitably officered and equipped, to make surveys and soundings along the North Pacific coast, beyond the limits of the United States, and to aid in prosecuting the work; and finally, a stipulated compensation for the Government use of the line when it shall be constructed.

Of all this Mr. Seward approves.

In regard to the Atlantic telegraph, no doubt is now felt that the work of laying the cable will be seriously undertaken next summer. Glass, Elliot, & Co. are preparing the cable, and it is understood that the Great Eastern has been engaged to aid in putting it down. The French Atlantic scheme is also spoken of as likely to be carried into execution without delay. Of Mr. Shaffner's project, for which concessions were obtained from the King of Denmark, commonly known as the North Atlantic Telegraph, nothing has been heard for some time.—*New York Weekly Journal of Commerce.*

HAWORTH'S PATENT FOR CONVEYING ELECTRIC SIGNALS AND TELEGRAMS.

We publish this week a document which will be read with considerable interest by every one interested in the progress of electro-telegraphy. Mr. Haworth's discovery, of a method of transmitting intelligence between distant places without the aid of conducting wires, has been the subject of discussion for some time. After carefully perusing the lengthy and intricate specification, and the twelve sheets of drawings attached thereto, we confess that the means proposed by Mr. Haworth are incomprehensible to us. We have reproduced two of the drawings, which will, perhaps, to some extent assist our readers in mastering the more unintelligible parts of the specification. It is to be hoped that the inventor will now lose no time in putting his invention to practical test in the presence of competent and credible witnesses. The following is an abstract of Mr. Haworth's specification:—

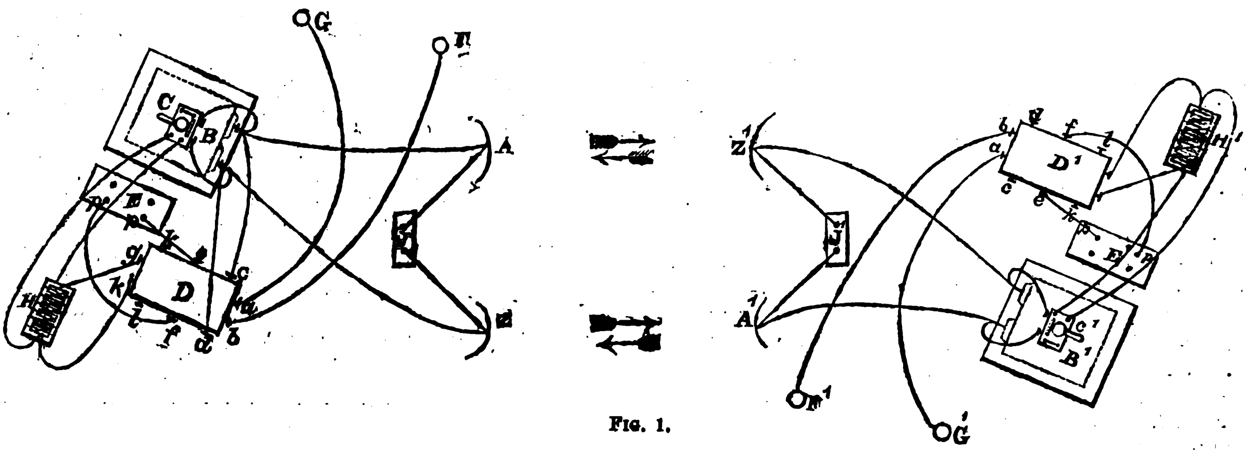

FIG. 1.

In order to effectuate the object in view, the patentee proceeds as follows:—A plate of copper, marked A, and another plate of zinc, marked Z, each separate and distant about three feet from each other, are buried in the earth, but the distance between these plates may be advantageously increased to some extent in proportion to the distance to which the signal is to be sent. They are retained in an upright position and slightly bent, so as to form the segment of a cylinder, the axis of which is perpendicular to the surface of the earth. They are buried in such a position as to present their convex sides towards the place to which it is intended to send signals. For a distance of seventy-five miles and under, it has been found that plates of one foot square are sufficient. For a distance beyond that, and up to 440 miles, plates each 24 inches by 16 inches have been made use of, but the size of the plates may be varied according to distance, or other circumstances. Two cylinders of copper, marked G and F, each two feet long and four inches in diameter, are also buried in an upright position. These cylinders must be buried in the earth at such a depth as will insure their always being surrounded with moisture. They must be separate from each other. Their position is shown in Fig. 1. There are also buried in the earth, behind plates A and Z, at the distance of about three feet from the centre of each plate (the distance may be increased for longer distances, as above mentioned), and in an upright position, a wooden box, marked J, containing a coil of coated copper wire.

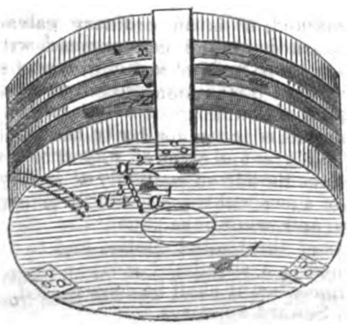

FIG. 2.

The coil which has been found effective is of a flat form, Fig. 2, one inch in thickness, and consists of coated copper wire wound upon a reel, constructed as follows:—Two circular pieces of wood are fixed, of the diameter required, upon a wooden axle, and at right angles thereto. These pieces of wood are kept separate, at an uniform distance, by a circular block or collar of wood of the thickness required; upon this collar is wound the coil in regular successive layers to fill up the reel. The collar used is one inch thick and three inches in diameter; the diameter of the coil in this case is fourteen inches, and for this coil, copper wire, No. 16, insulated, has been used. The reel may be made of wood, well coated with shellac, or other insulating material, or glass. The end of the wire at the centre, and that at the circumference, are connected respectively with the binding screws, shown on box J, Fig. 1.

The binding screws of the box J, are connected with plates A and Z, by means of coated copper wires, to each end of the coil, in an apparatus hereinafter described, and marked B. This apparatus, marked B, consists of a strong wooden box, containing three flat coils, constructed in the following manner:—A reel is made, by fixing four circular pieces of wood, not less than eight inches in diameter, and well coated with shellac, on a wooden axis at right angles thereto, and at equal distances from each other; they are retained in this position by collars or circular blocks of wood placed between them, and also well coated with shellac. These collars correspond with each other in size and thickness. A reel with three compartments is thus obtained, and being of equal depth and width, these compartments correspond to the before-mentioned coils. The first compartment is filled with fine insulated copper wire, wound on the reel evenly and closely together, in regular successive layers, from the centre to the circumference. The end of the wire at the centre, and that at the circumference, are brought to the outside of the reel, and there secured. The next compartment is filled with thicker insulated copper wire, wound in the same direction as in the first coil, and in the same regular manner; the inner end of this wire is brought to the circumference of the coil by a groove up the partition separating coil x from coil y; both ends are secured outside the reel, and connected with the binding screws, as shown in Fig. 2. The compartment, z, is filled half-way up with coated iron wire, wound on

the reel in the same direction as coil *x*, and coil *y*. The ends of the iron wire are brought through the flat side of the reel to the outside of the reel, and there securely fastened. The remaining portion of the compartment, *z*, is then filled to the top with similar coated iron wire, but wound double and in a contrary direction to that in the lower half of the compartment, as indicated by the arrows. These wires are not twisted nor bound together, nor allowed to cross one another, but wound evenly in successive layers side by side. The ends of the coil, both of the single and double iron wire, are securely fastened on the outside of the reel.

The coils found effective for the transmission of signals for a distance of upwards of 400 miles, have been for coil *y*, copper wire, No. 16; for coil *x*, copper wire, No. 32; and for coil *z*, iron wire, No. 20, all coated. The reels on which these coils have for the last-mentioned distance been wound, measure fourteen inches in diameter, of which the collar in the centre occupies three inches; the thickness of the collar being one inch. But the size of the wire, the diameter of the coils, and their thickness, will vary according to distance or other circumstances. The partitions between the coils are three-eighths of an inch thick, and the external sides of the reel one inch and a-half thick.

Both ends of the before-mentioned coil *y*, in box B, are brought into permanent metallic connexion, by binding screws, with the end of the coil surrounding the magnetic needle of a telegraphic indicator, marked C. This indicator is placed over box B, as shown in Fig. 1.

Both ends of the coil *y*, in box B, are connected by wires with the binding screws *c* and *d*, in the apparatus hereinafter described, and marked D. The apparatus marked D (which is called the condenser) is contained in a wooden box, of sufficient dimensions to contain the plates and other material connected therewith, hereinafter mentioned. The box is divided lengthwise, by a partition, into two compartments; the interior is well coated with shellac. In each compartment a band of stout gold foil, well insulated, is placed. The band is securely attached at each end to the binding screws at the extremities of the compartments, that is to say, as to one compartment to the binding screws, *a* and *g*, and to the other compartment to the binding screws, *b* and *h*. Each compartment is filled with rectangular plates of gutta-percha, on which insulated copper wire is carefully wound. The wire on these plates of gutta-percha is passed from one plate to another in succession, so as to form one continuous communication throughout each compartment, and the extreme ends are attached to binding screws, *a*, *g*, *b*, and *h*, respectively. The binding screws, *c*, *d*, *e*, *f*, *k*, and *l*, are fixed in the positions shown in Fig. 1, connected with the wire upon the plates in its passage through the box, marked D, and then passed from end to end of each compartment over the gutta-percha plates, and lying upon them, but well insulated from them, another band of stout gold foil, similar to that described above, and each end of it connected with the above-named binding screws, *a*, *g*, *b*, and *h*. The condenser or apparatus marked D, used contains sixty plates of gutta-percha in each compartment, each plate being three inches by four and a-half inches, and nearly one quarter of an inch in thickness. The wire used is coated copper wire, No. 32, the gold foil is three and a-half inches broad, and No. 34 in the wire guage as to substance. For a coil of the dimensions of that hereinbefore described as contained in box, marked B, it is found that the apparatus, marked D, as hereinbefore described, will suffice. For a coil of lesser dimensions than that hereinbefore described in box, marked B, say one of eight inches in diameter, only twenty-five plates of gutta-percha are required in each compartment, and the gold foil one inch and three-eighths broad, only of a similar substance.

The binding screws, *e* and *f*, in the condenser or apparatus, marked D, are connected with binding screws, *p* and *p*, in an apparatus next hereinafter described, and marked E. The apparatus, marked E, contains two coils of copper wire wound upon a reel constructed with two compartments only, but in all other respects constructed in a manner similar to that described in reference to coils *x* and *y*, in the apparatus contained in box B. Each of the coils in apparatus, marked E, is constructed with two copper wires, the one insulated, and the other not insulated, wound alternately side by side evenly in successive layers, from the axis to the circumference. The coil in box E is formed of coated copper wire, No. 21, and copper wire not coated, No. 18. It is desirable that the coating of the copper wire, No. 21, should be of such a thickness that when wound the two wires may present as even a surface as possible. The other coil is formed of coated copper wire, No. 30, and copper wire not coated, No. 24; the inner and outer ends of the coated wire in the first coil are respectively connected with the binding screws, marked respectively *p* and *p*, and the ends of the coated wire in the above second coil are securely fastened on the outside of the reel. The ends of the uncoated wire in each coil are securely fastened on the outside of the reel in such a position that they can never come in contact with any uncovered part of the coated wire. Between each of the layers of wire is placed a strip of non-metallic paper, the width of the compartment, to insulate it from the layer above and the layer below, and when in winding within an inch of the circumference of the reel, gutta-percha tissue is employed, in addition to the non-metallic paper.

The binding screw, marked *g*, in the condenser or apparatus, marked D, is connected to one of the poles of a galvanic battery, marked H; and the binding screw, marked *h*, in the condenser or apparatus, marked D, with the opposite pole of the same battery. The battery used is Smee's battery, regulated according to the strength required.

The same poles of battery H are connected with the binding screws of an ordinary telegraphic indicator, marked C, so as to be capable of being brought into connection with its coil by the motion of the handle. It is suggested that all the wood used in the several apparatus before described be of well-seasoned wood, and, as a general rule, coated.

At the point to which it is intended to transmit the message or telegram is a set of apparatus similar in all respects with that hereinbefore described in Fig. 1, and in the earth is buried a zinc plate, marked Z¹, and a copper plate, marked A¹, similarly curved, and similar in size and position, and for similar uses as copper plate A, and zinc plate Z, hereinbefore described. The plates, Z¹ and A¹, should be buried opposite to, and with their convex sides towards, plates A and Z. The zinc plate Z¹ being buried opposite to the copper plate marked A, and the copper plate A¹ being buried opposite to zinc plate Z; a box marked J¹ is buried in the ground, containing an apparatus similar in all respects to the apparatus hereinbefore described, and contained in the box marked J. Box J¹ is placed at a distance, and in a position relatively to plates Z¹ and A¹, similar to that of box J, with plates A and Z.

Two cylinders are also buried in the ground, marked respectively G¹ and F¹; the cylinders marked G¹ and F¹ are of copper. These cylinders respectively are of the same dimensions, and are placed in the same position relatively to each other as the cylinders G and F hereinbefore described, and are connected with the apparatus contained in the box D¹, hereinafter mentioned, in the same way as the cylinders, respectively marked G and F, are connected with the apparatus in box D, hereinbefore described.

The apparatus contained in the box marked D¹ is similar in all respects to that hereinbefore described and marked D.

The apparatus contained in the box marked D¹ is connected with the respective apparatus, marked respectively B¹, E¹, H¹, and C¹, by a method similar to that in which the apparatus marked D is connected with the respective apparatus respectively marked B, E, H, and C.

The apparatus contained in the box marked B¹ is similar in all respects to the apparatus contained in the box marked B, and is connected with the respective apparatus marked D¹, E¹, and C¹, and with the plates A¹ and Z¹, in a way similar to that by which the apparatus marked B is connected with the respective apparatus marked respectively D, E, and C, and with the plates A and Z.

The apparatus contained in the box marked E¹ is similar in all respects to the apparatus contained in the box marked E, and is connected with the apparatus marked D¹ in a way similar to that by which the apparatus marked E is connected with the apparatus marked D.

The battery marked H¹ is an ordinary galvanic battery, and similar to that marked H, and is connected with the respective apparatus marked respectively D¹ and C¹ in a way similar to that by which the battery marked H is connected with the apparatus marked respectively D and C.

The apparatus marked C¹ is similar to the telegraphic indicator hereinbefore referred to and marked C, and is connected with the respective apparatus marked respectively B¹ and H¹ in a way similar to that by which the indicator marked C is connected with the respective apparatus marked B and H.

ADVANCEMENT.—In science there is work for all hands; and he is usually the most fit to occupy the highest post who has risen from the ranks.

THE INTER-CONTINENTAL TELEGRAPH.

As several paragraphs relating to the above great undertaking have appeared in our columns, we are now, through the courtesy of an esteemed friend, enabled to place before our readers the letters which have passed between Mr. Chandler and Mr. Secretary Seward on the subject :—

MR. CHANDLER TO MR. SEWARD.

Senate Chamber, Washington, April 14, 1864.

Hon. William H. Seward, Secretary of State.

Sir,—I have the honour to transmit herewith a printed copy of the memorial of Perry McD. Collins, representing that he has obtained from the Government of Russia a grant of the privilege to construct a telegraph from the mouth of the Amoor River to the Russian possessions in America, and a similar grant from the British Government in British Columbia, and praying the co-operation of the Government of the United States to enable him to complete his enterprise.

The Committee on Commerce of the United States Senate, to whom this memorial has been referred, will be glad to receive from you such information upon the subject as may be in the possession of the Department, together with your views upon the expediency of granting the prayer of the memorialist.—I have the honour to be, Sir, your obedient servant,

Z. CHANDLER,
Chairman of Committee on Commerce of the United States Senate.

MEMORIAL OF MR. COLLINS.

To the Honourable the Senate and House of Representatives of the United States of America in Congress Assembled:

The memorial of P. McD. Collins, a citizen of the United States of America, and a resident of the State of California, most respectfully represents: That he has obtained from the Imperial Government of Russia privilege to construct a line of telegraph from the mouth of the Amoor River, in Asiatic Russia, to the frontiers of the Russian possessions in America, adjoining the possessions of Great Britain.

In connection with the grant from Russia, the Russian Government stipulate, upon certain conditions, to construct a continuous line of telegraph connecting the European system with the Pacific Ocean, about 8,500 miles east of London, and on the route of a line which may be projected to Pekin and the great commercial cities of China.

Your memorialist also represents that, after having obtained the Russian grant, and upon a representation of the state of the case and the facts to the Government of her Majesty, that he has been authorised by the British Government to construct a line of telegraph across the intervening territory of British Columbia. Thus the grants from Russia and England authorise the construction of a continuous line of telegraph, which is to connect Europe with the United States, across the whole of Asia, and the northwest coast of the Pacific.

The whole country, except a portion of the route in British Columbia, over which this proposed line must pass, is sparely inhabited, and presents no local inducement for the construction of a telegraph.

The sole inducement to the construction of a telegraph over this great extent of country is the union of Asia and Europe with the American system of telegraph lines, and by as nearly as physically possible an overland route.

The great progress of telegraphs both in Asia and America since the proposition was originally made to induce a trial of this northern overland route, in order to unite Europe and America, has cleared away from the path of this enterprise many apparent difficulties suggested in the early stages of the undertaking.

Russia has extended her telegraph from St. Petersburg to Irkoutsk, a distance of 4,000 miles to the east; and now a line is being constructed along the Amoor River, which is to connect with the line in course of construction from Irkoutsk to the east. Thus it will be seen that Russia is rapidly approaching with a continuous line the Pacific Ocean.

On our side of the world we have already reached the Pacific, and up towards the British possessions, and as far as Portland, Oregon.

From our northern frontier, adjoining British Columbia, to the mouth of the Amoor River, in Asiatic Russia, the distance may be stated in round numbers at some 5,000 miles.

Previous to granting right of way for the construction of a telegraph, the Russian Government authorised your petitioner to survey a route over all that portion of the Russian dominions east of the Amoor on to British Columbia.

On two previous occasions your petitioner presented to Congress the facts of the case, and reports were made thereon, copies of which are herewith annexed, marked A and B.

The reasons which then existed not only hold good now, but are greatly enhanced by the absolute grant of right of way then withheld.

There is much in the North Pacific valuable to us as a nation in a commercial point of view, aside from the special interest particularly involved.

Our Pacific whaling fleet resort in considerable force to the seas, bays, and sounds, not only of the Pacific, but of the Arctic; in one year more than 70 American vessels have passed through Behring's Straits, and largely over 100 have visited the waters adjacent and the Otchotsk Sea.

The commerce of Japan and of the Amoor region increasing from year to year, makes it requisite that we should have a more perfect knowledge of these interesting regions of the North Pacific.

In view of the premises, and furtherance of American commerce and enterprise, and the vast and incalculable benefits to result to us, as a great commercial nation, out of the achievement of telegraphic communication which shall not only unite Europe to America, but add the whole of Asia, including Japan, China, and India, your petitioner most respectfully asks the favourable consideration of Congress, and that aid for a survey of the proposed telegraph, and a subsidy, in the form of a contract for the despatch of Government messages, be accorded, so as to meet the concessions of Russia and Great Britain in a co-operative, international spirit, and for general intelligence of all nations. And, as in duty bound, your petitioner will ever pray.

PERRY McD. COLLINS.

SECRETARY SEWARD TO HON. Z. CHANDLER.

Department of State, Washington, May 14, 1864.

To the Hon. Zachary Chandler, Chairman of the Committee on Commerce in the Senate of the United States:

Sir,—I have the honour to reply to your letter of the 14th of April last upon the subject of the memorial which has been submitted to Congress by Mr. Perry McDonough Collins.

Mr. Collins is an American citizen, residing in California. He has been, since 1856, commercial agent of this Government for the Amoor River. The public archives, as well as the records of Congress, furnish satisfactory evidence that the country could not have a more enlightened, assiduous, and faithful representative.

The project which he submits for the consideration of Congress is the construction of a line of telegraph from some point on the Pacific telegraph line, or the northern extension thereof in one of the north-western States or territories, across the border of the United States, and through British Columbia and Russian America to Cape Prince of Wales, thence by an inland route around the Sea of Ochotsk to the mouth of the Amoor River.

The telegraph line thus proposed is intended primarily to connect at the last-named place with a line to be extended from thence to Irkoutsk, the capital of Eastern Siberia.

At that important town a line of telegraph begins, which stretches through Yomsk and Orusk, in Western Siberia, Katherinburg on the Asiatic European frontier, Perin, Kasan, Nijni-Novgorod, and Moscow to St Petersburg, the capital of the Russian empire.

The line projected by Mr. Collins, from the Pacific Telegraph to Amoor River, with its anticipated extension by the Russian Government to Irkoutsk, would be the one link now wanted to supply direct and unbroken telegraph communication from Cape Race in Newfoundland, on the eastern coast of America, across the eastern and western continents and the Pacific Ocean to Cape Clear, in Ireland, the westernmost projection of Europe.

When a submarine telegraph shall be successfully laid between Cape Clear and Cape Race it will, together with the link I have last before described, complete a telegraphic circuit around the earth between the parallel of 42° and 65° of north latitude.

Three questions arise from Mr. Collins's memorial, namely :—1st. Is the enterprise feasible? 2nd. Would it be useful? 3rd. Has it a just claim on the Government to the patronage which he solicits?

The secretary then proceeds to discuss the three questions of the feasibility of the proposed route. He esteems the mere extent of the route to be traversed not insurmountable nor even a serious difficulty, the climate favourable, and if Congress shall grant the application, Great Britain and Russia, having already acquiesced, will not interfere. He leaves the expense of the enterprise to the estimate made by Mr. Collins in his memorial. He then says :—I proceed, in the next place, to consider the probable usefulness of the enterprise. It is needful here to assume that the line of telegraph proposed will be extended immediately from Amoor River to Irkoutsk, so as to complete the telegraphic chain over the two continents. The agreement of Russia leaves no room for doubt on this point.

It is quite too late at this day to debate the abstract question of the usefulness of the magnetic telegraph. It would be as easy now to dispense with the steam-engine on land or on sea, in the business of commerce, in social intercourse, or in political affairs, as it would be to forego the use of the telegraph. To be without it is to be isolated. Other conditions being equal, the country that has the largest extension and the most thorough radiation of the telegraph wire enjoys the most active and profitable system of domestic commerce.

Of the 80,000 miles of telegraph now in operation on the American continent, 60,000 miles are found within the United States, and the remainder in the provinces of British America. But commerce on the American continent defies political restraint, and centralizes itself within our own country. For practical purposes we may regard the whole telegraph system of the American continent as our own. But internal commerce imparts life to, and receives new life in return from, foreign commerce. In proportion to the extent and variety of its resources, the nation that enjoys the most prosperous foreign commerce exhibits the greatest industrial activity and domestic happiness within its own borders.

The vigour which commerce has already attained among us, while we continue to hold our communications with the eastern continent by navigation only, is justly a subject of national congratulation. Can there be a doubt that if our telegraph system should be connected by transoceanic line with the one that is now performing its equally isolated part on the eastern continent, new and stronger reciprocity would be exhibited not only in commercial centres, but in every recess of the land? The unremitting exertions which are made by enlightened men in Europe and the United States to connect the two countries by a wire passing through the Atlantic Ocean, as well as the responses which Great Britain and Russia have made to the application for favour and patronage to the line now under consideration, show the existence of a very wide and general conviction that each of the isolated telegraph systems existing on the two continents is imperfect and incomplete, and relatively inefficient, and that a connection between them is a necessary supplement to secure their greatest attainable usefulness.

The secretary proceeds to consider the question whether the enterprise deserves the patronage Mr. Collins solicits for it. Throughout the remarks which I have thus far submitted, I have not, without design, called it Mr. Collins's enterprise. It is truly his, because it was he alone who conceived and projected it, and who has clothed it with the substantial form which enables the great States, whose concerted action he solicits, to cause it to be put in operation. But in another sense it is entitled to be regarded as an enterprise of the Government of the United States. During all the time that Mr. Collins has been engaged in maturing and developing it, and presenting it to the consideration of Russia and Great Britain, he has been acting under the instruction and with the approbation of the Department of State, and a knowledge of that fact has not been withheld from Congress.

I think it may be regarded as settled that the United States cannot neglect to employ telegraphic communication with foreign countries, and yet expect to maintain a healthful commerce with them; that the United States cannot hope to inspire respect, confidence, and good-will abroad, and so secure peace with foreign States, without using the magnetic telegraph when it is possible; and that the United States cannot even hope to preserve peace and order at home, much less to maintain a military and naval police on their inland frontiers and around their ocean posts, without availing themselves of all feasible telegraphic communications.

Finally, it seems to me that in extending dominion over inland mountain regions, and setting up the national flag on the Pacific coast, the American people, however inconsiderately, assumed the duty of diffusing an equal civilization throughout the whole of the great country which they thus included within their borders. Nor would it be wise to shut out from our thoughts the consideration which necessarily results from contemplating calmly the positions and the resources of new north-western and western States. It becomes our duty to act upon the conviction that, from this time henceforth, those States are to perform an important part in a great work which shall make the shores of the Pacific Ocean the home of communities that shall be as busy, as prosperous, as free, as enlightened, as powerful, and as happy as those which now cluster upon the Atlantic shores. The Atlantic States, by their intermarriage with those of the Pacific, have come under an obligation to favour this great development.

What Mr. Collins asks of Congress is the grant of a right of way across the public lands, with the right to take therefrom materials necessary for constructing the line; the use of a national vessel, suitably officered and equipped, to make surveys and soundings along the North Pacific coast, beyond the limits of the United States, and to aid in prosecuting the work; and finally, a stipulated compensation for the Government use of the line, when it shall be constructed. If the views I have submitted are just, this demand for patronage is neither unnecessary nor unreasonable. We could not withhold it without showing a want of appreciation of the liberality and friendship which have been manifested towards the United States by Russia and Great Britain in the proceedings they have adopted towards the same enterprise. I do not know any one object lying within the scope of our foreign relations more directly important than the preservation of peace and friendship with these two great and enlightened Powers. Nor can I conceive of any one measure of national policy that would more effectively tend to secure that great object than the construction of the proposed intercontinental telegraph.

I forbear to urge the project in competition with the proposed line across the Atlantic from Cape Clear to Cape Race, which, notwithstanding past difficulties, I yet hope to see speedily completed. The two lines would naturally aid and strengthen each other. If they should even come into competition, it would be more advantageous to the world to have the use of both than the use of only one of them. One might be expected to operate when the other should be accidentally suspended. Nor can it be reasonably doubted that the great interests of human society will, at a very early period, require more than one, and more than even two, transoceanic, world-encircling telegraphs.—I have the honour to be, Sir, your obedient servant,

WILLIAM H. SEWARD.

METEOROLOGICAL PHENOMENON.—Towards the end of last month an electric cloud passed over Keith and Fife-Keith, in Scotland, occasioning a deposit of sulphurous matter on the surface of exposed water in the district as thick as a sixpence. The pools on the wayside were similarly affected.

THE PERSIAN GULF TELEGRAPH.

(*Continued from page 6.*)

To admit of more accurate reductions of the tests made in different temperatures to those made at the given temperature (24° centigrade), a series of experiments were instituted by Messrs. Bright and Clark, and carried out, to ascertain the resistance of the two materials at every 2° of centigrade between 0 and 38. The average resistance of the conductor at 24° centigrade was about 6·53 Siemens' units per nauticle mile, while the gutta-percha offers a resistance of 220 millions of units per nautical mile. This must not be confounded with the specific resistance of the two materials; the first is the total resistance of a piece of copper a mile long, and having a sectional area equal to the section of the conductor; the second is the resistance of a hollow cylinder of gutta-percha in the direction of its radius.

Its sectional area is approximately equal to the mean between the inner and outer circumference multiplied by one nautical mile, and the length of this conductor is the thickness of the gutta-percha covering.

The quantity of electricity passing through the conductor and insulator would be respectively inversely as these figures, or, in fact, on a length of one mile the quantity of electricity passing along the conductor would be 3,384,615 times greater than that lost by the conduction to the sea through the gutta-percha covering, and supposing a length of 300 miles, by a simple calculation we find that the quantity of electricity passing to the distant station would be 376 times greater than the quantity lost through the insulator on the whole 300 miles.

It was found that the resistance of the gutta-percha increased, when tested under pressure, about 16 per cent. per 600 lb. pressure. It also increased considerably with age: thus a coil which had, when tested on the 17th March, a resistance of 238 millions, had, when tested on October 23, 370 millions of resistance. The improvement with age augurs well for submarine telegraphy, and has been fully corroborated by the tests of the cable in the Persian Gulf. The joints in the core were all tested separately by a system devised by Mr. L. Clark, which admits of far greater accuracy in the detection of the minute leakage which occurs when a joint is imperfectly made than any system hitherto adopted. This system was fully described by Professor Thomson last May at the Royal Institution.

The core when tested was carefully wound on large drums in lengths of three to four miles, and delivered to Mr. Henley, at his factory at North Woolwich, to whom the contract for the completion of the manufacture of the cable was entrusted by the Government of India. The design of the protecting parts differs to some extent from that of other cables, and consists of, first, a serving of soft yarn wound round the core, which again is surrounded by twelve galvanized iron wires of No. 7, Birmingham gauge, of 0·18 of an inch diameter. As has been already pointed out, such a cable, though far more protected than the Red Sea or Mediterranean cables, by reason of the increased quantity of iron and the galvanizing of the latter, would still be liable to perish from rust at places after some time. As a further precaution, therefore, the following coating, designed by Messrs. Bright and Clark, was placed round the iron wires:—First, a serving of the best Russian hemp yarn is wound round the iron cable, and is then covered with a thick layer of mineral pitch, mixed with silica and applied warm. This is again covered with a second serving of hemp in the reverse direction to the first, and in its turn is again covered with another coating of warm compound, the whole finally passing through grooved rollers, so as to consolidate the whole and to produce a smooth and cylindrical surface. Thus the iron wire is effectually protected from contact with the water by a solid cylinder of hard asphalte, bound together by innumerable fibres, acting, as it were, as bond courses. This process has been already adopted in a less perfect manner on cables in the North Sea and Irish Channels, when only one serving and coating, however, was used, and has been found an excellent protection against rust.

The machines for applying this coating consist of two tanks, the one behind the other, and heated by steam jackets. In front of each of these is a disc carrying bobbins, on each of which is wound a length of hemp yarn. The cable passes through mandrils, on which the discs are attached, and over (not through) the compound in the tanks, the compound being lifted and poured on to the cable, as it passes along, by means of a small wheel with internal paddles; any superfluous compound that adheres to the cable being removed by a movable dish.

These machines, of which there were six, together with an iron shed over all the cable tanks, as required by the specification, and various fittings and preparations for testing, had to be designed and erected especially for this work.

Owing to the engineering knowledge possessed by Mr. Henley (a knowledge rather scarce amongst submarine telegraph contractors) and his readiness to oblige and meet the views of the engineers (a quality still more scarce among submarine telegraph contractors), many little difficulties in the adaptation of the necessary machinery were speedily overcome; and, indeed, when we consider that the contract was only let in December, it reflects the highest credit on Mr. Henley and his engineer, Mr. Frasi, when it is stated that the cable was fully started in February. The cable, as manufactured, was coiled into tanks and kept submerged in water; tests were taken of the core both on the arrival at Woolwich from the Gutta-percha Works, and every day on each section under manufacture by

a staff of electricians, under Mr. F. C. Webb, who superintended the manufacture of the cable on the part of Messrs. Bright and Clark, as also the shipping of the cable, the designing of the machinery, and fitting of the ships.

To ensure a perfect test of the core of insulation, the hemp serving between the core and the iron wire consisted of white Russian washed in salt water (a system patented by Mr. Willoughby Smith), as it has been found in practice that when the hemp is tarred a faulty place may be stopped up by the tar, and thus the cable will test, until the tar is dissolved, which sometimes does not occur until the cable has been submerged for some weeks or months.

The shipping and laying the Persian cable presented also some points of novelty and interest.

Most cables have been laid from steamers, and in the few instances in which sailing vessels under tow have been employed, the result has been (except in one instance, viz., the Dover and Calais cable) * the loss of the cable.

Thus one of the cables from Cagliari towards Bonah was lost, and another across the Gulf of St. Lawrence. To have taken a cable of the length of the Persian Cable, weighing about 5,000 tons, round the Cape in steamers would have been a considerable expense as compared to the cost of the whole work. Besides which it would have been very difficult to obtain sufficient steamers of the necessary construction for taking large coils without considerable delay. The idea of sailing vessels under tow was, therefore, once more discussed. It was shown on good authority that the prospect of fine weather in the Persian Gulf during the months of spring was considerable, and as the route of the cable lay in shoal water, where it could easily be grappled if any mishap should take place, it was determined by Colonel Stewart to try once more this more economical mode of laying a cable. And it is only due to Colonel Stewart to observe that in deciding this question he was opposed by most of the engineers; and, indeed, certain contractors and their engineers laughed at the idea. At the same time it is obvious that as a sailing vessel under tow cannot be stopped so easily or quickly when required as a steamer, this mode of laying a cable imposes a more arduous task upon the engineers actually employed in the operation of laying, and by whom, in in this instance, every precaution was therefore taken to avoid, as much as possible, the occurrence of any hitch in paying out.

There remained, however, still the difficulty of the change from hold to hold, and in which case the calculation of the time the ship will lose her way requires, accordingly, the greatest nicety of judgment.

The Marian Moore, of 1,036 tons, Captain Munce; the Kirkham, 1,061 tons, Captain Routledge; the Tweed (late the Punjaub), 1,744 tons, Captain Stuart; the Assaye, 1,528 tons, Captain Thomas; and the Cospatrick, 1,199 tons, Captain Elmslie, were taken up by Government. In addition to these ships, the Government purchased a small screw steamer of 441 tons, called the Charente, and re-named her the Amber Witch. This vessel was fitted with three water-tight tanks, for receiving cable, a break, and a complete machine for picking up (*i.e.*, winding in) cable by steam, and, indeed, with all other machinery for grappling, buoying, under-running, picking up, and laying cable. She is to be stationed in the Gulf as a general means of relieving the staff and provisioning the stations, as well as for repairing the cable should it break down at any time.

She is commanded by Lieutenant Stiffe, late of the Indian Navy, an officer of much experience in surveying duties in the Gulf, and who, in addition to his experience as a naval surveying officer, has served his time in a civil engineer's office in London. Captain Stiffe, besides commanding the Amber Witch, will hold the office of engineer to the line; and there is little doubt that a better officer for the work could not have been selected.

These five large vessels were fitted each with three water-tight cylinders, or tanks, to receive the cable. These cylinders, which were mostly elliptical on plan, varied in dimensions from 23 feet by 26 feet in diameter, by 10·3 feet deep (viz., the fore tank of the Marian Moore) to 32 feet by 34 feet diameter, by 15 feet deep (viz., the main tanks of the Assaye and Tweed).

In the centre of the tanks a solid wood centreing was fixed in the shape of the frustrum of a cone, and having a perfectly smooth surface, rounded off at the top edge to a radius of 1 foot. Round this cone, and near the top a ring was fixed, leaving a clear space entirely round the cone, and between it and the ring. A second ring, of larger dimensions, and in some cases a third, is fitted with machinery, so as to lower down, and yet remain rigid in any place to which it is lowered as the cable is payed out.

Between these rings and the cone the moving part of the cable passes, and sweeps regularly round, being guided in its course by the cone on the interior, and the rings on the exterior, of its path. Above the centre of the cone is fixed a bell-mouthed casting, through which the cable passes. This was so contrived that, by the removal of a single pin, it could be opened to free the cable when changing from hold to hold.

The rings were also fitted with loops or bays, in which the bottom part of the cable leading to the next hold was placed. The rings being made complete by means of a solid piece, secured by two pins, are easily removed by a hammer.

From the cast iron hawse the cable passes over a cast iron saddle or quadrant, fitted with rollers in some cases, and thence it changes to a horizontal direction along a series of fair leaders, having rollers in them fixed on a long platform erected in a fore-and-aft direction along the ship. This platform is placed at such a height, and at such a gradient, as to lead the cable with the least bends possible to the machinery for paying out. The system of cones and rings is claimed as a patent by Mr. Newall, and the Government pay a royalty for its use. The particular proportions of the cones, and the mode of arranging the fixed and moving rings, and the arrangements for maintaining the latter firm, together with some improvement in the latter which prevents the necessity of taking out a whole segment of the ring when changing from hold to hold, were designed by Mr. F. C. Webb, when fitting the ships. The break consisted of a cast-iron drum, 6 feet in diameter, and having a break similar to a crane break on one side, fixed on a 7-inch shaft, 6 feet long, supported on two bearings on the same side. On this shaft a second break wheel was fixed 5 feet in diameter. The cable made four turns round the break drum, and then passed over a 4-feet sheave fixed over the stern of the ship. The 5-feet break was used in general, the larger break being only used as a precaution if it should be found necessary to restrain the cable at all costs to save life or limb.

The cable was coiled on board the ships as they arrived in succession opposite the factory at Woolwich, under the superintendence of Sir C. Bright and Mr. F. C. Webb; Mr. Henley also undertook this part of the work by contract. As the cable was coiled on board, the tanks were filled with water, and, when filled with cable, decked over. One of Gwynne's centrifugal pumps, worked by a small steam-engine, was fitted to each ship, for pumping the tanks up should they at any time require pumping out or filling. Each ship was fitted with proper instruments and batteries for testing the cable in a cabin fitted up especially for the purpose, under the superintendence of Mr. J. C. Laws, and the cable was tested regularly every day during the passage out by one of Messrs. Bright and Clark's staff, sent in charge of the cable; Mr. Wood being in charge of the cable in the Assaye, Mr. Moseley in the Tweed, Mr. Walker in the Kirkham, Mr. Donovan in the Marian Moore, and Mr. Crookes in the Cospatrick.

The ships left Woolwich, or Victoria Docks, on the following dates:— Marian Moore, August 15th; Kirkham, September 11th; Assaye, September 23rd; Amber Witch, October 21st; Tweed, October 24th. The Assaye, which put into Plymouth with her mainmast sprung during a gale, was detained to have a new mast fitted, and sailed finally October 14. The Tweed also put into Torbay through stress of weather, and sailed finally November 6th. The vessels arrived at Bombay in the following order:— Marian Moore, December 22nd, 1863; Kirkham, January 13th, 1864; Tweed, February 6th, 1864; Assaye, February 12th, 1864; Amber Witch, March 2nd, 1864; Cospatrick, April 16th, 1864. As soon as the Marian Moore and Kirkham had arrived at Bombay their machinery, which had been stowed for the voyage, was again fixed, and every arrangement made for paying out, under the superintendence of Sir Charles Bright, who had arrived with his staff at Bombay on the 10th of December; the electrical arrangements being in the charge of Mr. J. C. Laws, and the arrangements for paying out under Mr. F. C. Webb,—the general arrangement for the departure of the ships being made by Colonel Stewart and Captain Young, C.B., the captain superintendent of her Majesty's dockyard.

On January 21st, the Coromandel, Captain Carew, having on board Colonel Stewart, Captain Stewart, Sir C. Bright, and Dr. Esselbach, left Bombay, and in the evening of the same date was followed by the Kirkham, in tow of the Zenobia, Captain Carpendale, and the Marian Moore, in tow of the Semiramis, Captain Crocket.

(To be continued.)

THE NEW GUM, BALATA.—At a meeting of the Society of Arts, held at Willis's Rooms, on the 24th ult., His Royal Highness the Prince of Wales presented the silver medals of the Society awarded to Dr. Van Holst, of Berbice, for the importation into this country, through Mr. Walker (Colonial Secretary of British Guiana), of specimens of balata, a gum from the *Sapota Mulleri*, as a substitute for gutta-percha; and to Sir William Holmes (of British Guiana), for the introduction of this material into the commerce of the country. Mr. M. H. Marsh, M.P., in adverting to the awards, said "They were all aware of the great commercial value of gutta-percha. It was a material which had been introduced only within the last few years, and it was now of the most extensive application. It was used for objects of great variety of character, from the half-penny toy of the child to the great electric telegraph which could waft a sigh from India to the Pole, defying space and time, and which was one of the greatest discoveries of the age, when mind triumphed over matter in a way that no previous age had witnessed. Gutta-percha was a natural production; its sources of supply were limited; the trees from which it was derived were continually cut down, and the supply must ultimately fail, and hence the importance of discovering some efficient substitute. The eminent colonists to whom the society's medal was awarded had been fortunate, the one in discovering, and the other in introducing into commerce a gum of another kind which could be used as a substitute for gutta-percha, and he was sure the meeting would agree that they were immensely entitled to the distinction which was now conferred upon them."

* In this instance also the towing hawser broke, and the ship containing the cable drifted so much that the cable ran short, and was not completed until some weeks afterwards.

THE AMERICAN COMMISSIONER ON THE POLICY OF PATENTS.

(Concluded from page 9.)

(Concluded from page 9.)

I proceed next to a review of the progress of the arts in this country within the last one or two years, as exhibited in the different classes of inventions which have been the subjects of examination during this period. For minute information reference must be had to the carefully prepared brief descriptions of all the patented inventions, with the claims of each patent for the present year, and the admirably executed plates of drawings which accompany this report.

I am withheld, for obvious reasons, from giving the names of particular inventors, even when they may have exhibited extraordinary merit, and shall attempt only such a general sketch as may indicate the direction which the industry of the country has taken, and may be suggestive to ingenious minds of the fields of invention in which there is the most promise of reward for exploration and discovery.

Upon assuming the head of this office, I found the classification of inventions, by means of which the work of examination was distributed into distinct departments, and the vast collections of drawings and models arranged for ready reference, defective in philosophical arrangement, while the development of new branches of industry exhibited the need of forming new classes; I therefore prepared a new classification of the subjects of invention, which was published for the guidance of the office, and for facilitating inventors and agents in their reference to drawings and models.

The alphabetical classification extends over many pages, embracing a consideration of nearly every process in the arts and manufactures; but as our readers are more particularly interested in telegraphy, we pass over the subjects until we come to class N, which treats on mathematical and philosophical instruments, electricity, &c., where the American Commissioner says:—

In almost every subdivision of this class inventive genius has been successfully active; and although the subjects are apparently among the most peaceful pursuits of life, yet the present war has elicited some valuable contributions to the progress of improvement in this connection. Among the patents intended more particularly for army and navy purposes are telegraphs for the field and for use on shipboard, for steering purposes, and communication with the engineers; electric fuzes for cannon and blasting, torpedoes, signals on land and at sea, telescopes for rifles, telescopes for measuring distances, field glasses, mariners' compasses for iron-clad vessels, and others of indirect relation, such as portable scales for weighing and engineering apparatus, designed especially for army and navy uses.

These have all passed in review and received the sanction of letters patent. Conspicuous among them is a magneto-electric telegraph, now in extensive use in the United States army for field purposes, and elsewhere for ordinary telegraphic purposes. This is a signal triumph in electro-mechanics, for by the motive power of a small magneto-electric machine, occupying less than a cubic foot, a dial or index telegraph is operated through great distances, from five to two hundred miles, with the prospect of greater and indefinite extension. It was found with the Atlantic telegraph in 1858, that alternating or to-and-fro currents were indispensable to its operation, and the magneto-electric machine of the telegraph before us has the peculiar movement of normal to-and-fro currents in rapid succession, without any extra contrivance for their production, this condition growing out of the very arrangement of the magnetic poles and helices. The operators for this telegraph require no training, and any person who can read can telegraph. For the Morse telegraph two or three years of training are required. It is not liable to piracy by tapping, as is the Morse telegraph, and may be justly regarded as the inauguration of a new era in telegraphy, by dispensing with the cumbersome, uncleanly, unhealthy, and inconstant galvanic battery as the motive power, and the introduction of a simple and economical telegraph, adapted with equal facility to domestic and public purposes. It is not too much to say that the days of telegraphing by the galvanic battery are numbered, and that the magneto-electric machine will ere long take its place for this as well as for many other purposes.

Another highly interesting development in magneto-electric science is the discovery and application of a new mode of ignition for purposes of blasting with powder. Hitherto torpedoes and other powder blasts, fired by electricity, have depended upon the ignition of a very fine platinum wire. When this had to be done through long circuits or at great distances, very large and expensive galvanic batteries were required, owing to the great diminution of the quantity of electricity. It was proved by experiments made at the Capitol many years since that 150 pairs of Grove's battery were necessary to ignite powder by the finest of platinum wires placed in the telegraphic circuit between Baltimore and Washington, a distance of forty miles. By means of this new discovery powder has been fired through the distance of 100 miles by means of a little magneto-electric machine, occupying less than a cubic foot. This astonishing achievement has been accomplished by means so simple that electricians will wonder as much, if not more, than the uninitiated. It is done by a *pencil-mark*. The stroke of a common blacklead pencil on a block of wood is substituted for the platinum wire, and this disintegrated conductor, as it may be called, is so intensely ignited by the magneto-electric current as to set fire to the wood.

The application of this ingenious device within a suitably prepared cartridge will be hailed as one of the most valuable contributions to mining and engineering operations of the present day.

Following upon this discovery was an interesting application to the firing of cannon by magneto-electricity, dispensing with the vent or touch-hole, which, although hitherto a necessity, has been regarded as a weak point in cannon.

Experiments made at the navy yard in this city prove the firing by this method to be wholly successful, one thousand cartridges having been fired by the inventor without a single failure.

A patent has been granted for an electro-magnetic telegraph for steering vessels, and public exhibitions made of the practical operation of the system. By very ingenious mechanism, the orders of the pilot to the engineers and helmsmen are given with such promptness and unmistakeable precision, that its early introduction, especially in the immense vessels of the present day, may be reasonably looked for.

The electric and magneto-electric lights have also been subjects of examination and of patents, and there can be no material doubt now as to the practicability of the magneto-electric light for lighthouses and other purposes of signal lights.

The magneto-electric current passing between charcoal points has been used in a lighthouse at Dungeness, on the English coast, since 1862, and the light is said to possess more power of penetration than any other light.

From these and other cursory observations of the recent developments of magneto-electricity, flattering promises rise up in the contemplation of its future.

The steam-engine is hardly eighty years old, and the magneto-electric machine hardly thirty. It is only about forty years since the steam-engine was fairly appreciated, and hardly a decade since the magneto-electric machine was duly recognised in the family of practical mechanics, and if its future career should be commensurate with its past, it will take high rank among the great engines of human progress.

Some ingenious contrivances have been made with a view to prevent the local influence of iron in ships on the mariner's compass, and especially for use in iron-clad ships. These are in connection with the water compasses, in which the needle swings in a liquid, and the box so elevated above the mass of iron in the ship as to be beyond its influence, while the deviations of the needle may be observed from below.

In one instance, it is asserted that a peculiar arrangement of wires, conveying an electric current, operates so as to completely intercept local influences, and not interfere with that of the earth or produce any local effect of its own. The office has had no verification of this improvement.

In concluding this report I am impelled to present in prominent relief the important fact that, although the country has been engaged in a war which would have seemed to tax to the utmost all its energies, the applications for patents for the last year have been equalled in only two former years; and yet one half of our territory, shrouded in the cloud of rebellion, has contributed nothing to invention or human improvement.

The institution which has blighted that portion of the republic has long since recorded in this office its adverse influence to the arts and civilization. It appears that in the year 1857 there were granted to citizens of Massachusetts 421 patents, being a proportion of one to a population of 2,362. In the same year there were granted to citizens of Virginia 58 patents, a proportion of one to 24,511; to North Carolina 14 patents, a proportion of one to 62,064; and to South Carolina 12, a proportion of one to 55,708.

Labour being degraded in these States, there was no stimulus to mechanical activity; and as labour-saving machines were supposed to have the effect of supplanting and diminishing the value of slaves, improvements were regarded as injurious to the paramount interest of the State. It was only by unparalleled efforts that a northern inventor succeeded in introducing into the cotton States the gin, which added a hundredfold to their productiveness and value. This invention is an example of the benefit which the South will derive from new arts to be applied to her peculiar climate and products.*

The imagination fails to conceive of the happy future in store for this country when its fairest portion shall be regenerated by the adoption of a just system of labour, and conquered by free industry; when its land, by this change, shall, according to the remarkable estimates of Mr. Walker, have an increased value of over six billions of dollars; and when a whole race shall be taught to think, contrive, and create. The richest field of invention, with its fruits of wealth and prosperity, will then be opened that ever occupied the faculties of man. The visions of Virgil and Milton will be realised, and

> "Time will run back and fetch the age of gold."

D. P. HOLLOWAY, COMMISSIONER.

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* In an interesting work lately published, entitled "In the Tropics, by a Settler in Santo Domingo," the author says:—

"Those who say the treasures of the tropics are to be best won by the brute force of ignorant labour cannot have studied with sufficient patience the march of invention.

"Intelligent labourers—men who know how to make wood and iron perform the severest part, to the sparing of human sinews—men who can work steam in harness—these are what is wanted here.

"Under the warm sun of the south *intelligent men and machinery will yet open the grandest field of civilization ever realised.*

"Even in such a small matter as hoeing a cornfield this is illustrated. Without violent labour I do as much clearing in a short forenoon with my little donkey cultivator as three good field hands in a whole day, and do the work much more effectually. Rating the donkey and myself as equal to a pair of Dominicians, the cultivator, which neither eats, sulks, nor runs away (to which as a class they are subject), counts for four common hands, which are subject to all those defects. The cultivator, I repeat, counts for four labourers, and asks no wages."

CORRESPONDENCE.

THE MALTA AND ALEXANDRIA CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The following item is included in the Estimates of the House of Commons for the current year—£680 for the Malta and Alexandria Telegraph. Taking into consideration the enormous traffic and consequently large receipts on the above line, it appears to me inexplicable that the country should be called upon to contribute towards its maintenance. The income, I believe, exceeds considerably £2,000 per week, or £104,000 per annum, but I cannot find that any portion of this large amount has found its way into the Treasury. The cable cost the country upwards of half a million of money!—Yours, &c., ONE OF THE PUBLIC.

TOADYING CRITICISM.—CULLEY'S HANDBOOK.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have been vastly amused by a small criticism in the *Practical Mechanics' Journal*, of 1st July, on a book which all of us have admired, and most of us profited by. The author of the dozen lines—(I wonder he did not expand it a little with adjectives)—after subduing his praise by telling us that no good books on telegraphy exist in English, says:—"Our English telegraph engineers, generally, do not possess the sound rudimentary training in mathematics and physics, including *chemistry* (!), which are indispensable to clear authorship on this complex subject, and which is given in Germany, through its *magnificent* system of education in the gymnasia and universities, to every German engineer. A very small proportion of English engineers, in any branch of the profession, possess an university degree of any sort, unless it be some D.C.L., or LL.D., too often the tribute of toadyism rather than the proof of scientific knowledge."

An opinion so erudite in itself, and, doubtless, so pleasing to the *modest* German engineers, must necessarily be highly gratifying to English electricians—the inventors and discoverers of seventy-five per cent. of the existing electrical laws and telegraph systems—therefore I call your attention to it.

Probably if the Germanised critic of the *Practical Mechanics' Journal* had a little more intimate knowledge of the senseless dissipation and supreme humbug and Barnumism of the "magnificent system" with which he is in extacies, he would next time look in another direction for inspiration for his "lines."—Yours, &c., WILBERFORCE PETERS.

London.

THE PREVENTION OF RAILWAY ACCIDENTS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Having perused your observations on railway accidents, in the *Telegraphic Journal* of 2nd inst., No. 27, I deem it may be of interest to you to receive information upon the means employed on some of the railways in France to prevent accidents, by the use of Mr. Edward Tyer's electric signals.

You will find enclosed a list of thirty-eight stations on the Paris, Lyons, and Mediterranean lines, some of which have been in continual operation since June, 1856, and the others in progression. Ten are employed on the Eastern (Paris and Strasburg) line, and have given satisfaction, no accident having occurred where they are placed.

I enclose printed directions, published under a decision of the Minister of Public Works, and signed by the director of the Paris and Lyons Railway, which are given to the parties under whose directions these machines are placed. You will also find a list of the stations on the Paris and Lyons Railway where they are established, and where no accident has ever occurred.—I am, Sir, yours truly,

Paris, July 4, 1864. JAMES POWER.

NOTE SUR L'EMPLOI DES APPAREILS À SIGNAUX ÉLECTRIQUES POUR CONJURER LES ACCIDENTS SUR LES CHEMINS DE FER. SYSTÈME TYER.

Le chemin de fer de Paris à Lyon, sous la direction du chef de mouvement, M. Poirée, les a employés en 1856 et 1857, aux gares de Paris et de la Banlieu, ainsi qu'aux tunnels de Blaisy et de Perrache, où ces appareils sont en operation constante depuis.

A Blaisy, deux appareils ont été installés le 1 Juin, 1856, l'un à chaque entrée du tunnel qui est d'une longueur de 4,100 métres, avec pente de 0.004m. un au poste de Blaisy, l'autre au poste de Baulme la Roche; ils ont pour but d'empècher de laisser s'engager deux trains à la suite l'un de l'autre sous le tunnel; on ne laisse entrer un train que lorsque l'on sait par les indications des appareils, que le train qui précedes est bien sorti du tunnel.

Au tunnel de St. Irénée, qui separe les gares de Lyon, vaise et Perrache, un appareil a été installé à vaise et un autre à Perrache le 1 Septembre, 1857. Ce tunnel a 2,100 mètres de longueur avec pente de 0.003m.

Bien que ces appareils n'aient pas été employés sur le chemin de fer de Lyon pour prévenir les rencontres de trains, dans les courbes et tranchées profondes, il est indubitable que dans cette circonstance, ces appareils seraient de la plus grande utilité.

Les appareils sont installés dans les gares suivantes depuis le 1 Mars, 1857, jusqu'à Melun et les autres successivement, et ont pour but d'empêcher deux trains, de s'engager à la fois sur la même voie dans l'intervale qui separe deux postes consécutifs:—Gare de Paris, Bercy, Charenton, Maison d'Alfort, Avenue de Choisy le Roi, Villeneuve St. Georges, Mongeron, Brunoy, Combs-la-Ville, Lieu Saint, Cesson, Melun, Bois le Roi, Fontainebleau, Thomery, Moret, Darcey, Gissey, Boux, Verrey, Tercey, Blaisy Bas, Baulme la Roche, Malain, Beuchail, Velars, Plombières, Dijon (Chartreux), Dijon (Misericarde), Dijon (Bifurcation), Vaise, Perrache. Sur la ligne de Toulon, 2; au Souterrain de la Nerthe, 2; ditto de l'Ollioule, 2.

Paris, Octobre 31, 1861.

Au mois de Juillet, 1862.—2 appareils simples ont été installés pour le Souterrain de Courzon (Loire), Section du Bourbonnais.

Janvier, 1861.—Chemin de fer de l'Est, 8 appareils simples.
Ditto ditto 2 ditto

EXPERIMENTS ON THE PNEUMATIC SYSTEM.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your last number there appeared a long account of experiments made at Liverpool on the pneumatic system, quoted from one of the daily papers of that town, and to which you have appended the following remark: "We do not hold ourselves responsible for the statements contained therein." It is not often that one reads in a public paper statements so utterly contemptible as those contained in the account in question. The *inventor* and patentee of the system, Mr. Latimer Clark, is ignored, his name not being even mentioned by the "*chiel*" *intitioned* "*to tak' notes and print 'em.*" I hope that the *Telegraphic Journal* will some day enable its readers to learn the true history of this valuable invention.—Yours, &c.,

July 7, 1864. A LOVER OF FAIR PLAY.

JOINTS IN TELEGRAPH CORES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—As one having had some experience in the making and testing of joints, and the speedy failure of joints when slovenly and imperfectly made, as was the case with the first Atlantic cable, permit me to offer a few remarks upon the subject. I have generally found that when the insulation of subterranean gutta-percha covered wires is impaired it is owing to the defection of a joint imperfectly made. Anyone who will take the trouble to look at the joints in the covered wires when they have been taken out from under the pavements of the metropolis for repairs, can easily satisfy himself upon the point. The coatings of the joint will be found loose and rotten, while the other portions of the wire are in an excellent state of preservation. I believe, like your correspondent "A. J. T.," that no efficient and durable joints can be made in the insulating substances hitherto introduced, except pure gutta-percha and masticated india-rubber. The absence of homogeneousness in every other material renders a sound joint impracticable, however well the machine-made portions thereof may test. The lamentable results of imperfect joints will be seen from the following quotation from the Report of the Government Committee on Telegraphs:—

"Was not the cable cut up into a great many lengths at Keyham, at Greenwich, and on board the Agamemnon, during the different trips?—No doubt there was a great deal too much recklessness in cutting the cable from time to time; that is to say, if a test was wanted, the first thing was to call for a person to cut the cable and begin to test, and then it had to be joined up again.

"Did not they very frequently, in testing the cable, prick for the wire?—That was done occasionally, I am aware, but in very many instances there was a positive cut. I have been informed by Captain Kell that the cable must have been cut into at least a hundred pieces at one time or other. Either from that cause, or from some other cause, this fearful result has taken place which is exhibited by these four joints—(*producing the same*)—which have been cobbled up again. I do not know whether they were in the original cable, or whether they were the result of cutting, but those are joints which I have taken out of a portion of the cable.

"Professor WHEATSTONE: Before the cable was submerged?—Yes, these have never been submerged.

"CHAIRMAN: What portion of the cable were those joints taken from?—They were taken out of the portion of the cable manufactured by Messrs. Newall & Co.; but I must not be understood from that to state, by any means, that they were made by Messrs. Newall. I cannot identify by whom they were made, but I can state that they were in that portion of the cable.

"Mr. VARLEY: How can you state that?—I can state that from the fact that that is flattened hemp, whereas in Messrs. Glass & Elliot's cable the hemp is spun, and then laid into strands; that is the reason I can identify it.

"CHAIRMAN: Newall's was flattened hemp?—Yes, laid flat round. Glass, Elliot & Co. laid theirs in strands round, and that enables me to

identify it. I have placed a properly made joint by the side, to show the contrast.

"Mr. VARLEY: It is very possible that a joint of this defective description may account for the sudden cessation of continuity, and its reappearance afterwards when the cable got to the bottom, owing to its separation by the stretching of the cable, and then coming together again.

"Mr. SAWARD: We have been assured by competent persons who have specially examined the cable on behalf of the company, that the slight defects which I have mentioned as existing before the cable was laid, were increased after the cable was down by the injudicious use of battery power, and the cable now lies in a state in which, although it may again, by great care, perhaps be got to work once more to a very moderate extent, can scarcely be hoped ever to fulfil the expectations which arose regarding it from the working after it was first laid.

"CHAIRMAN: Are you aware whether the statement made by Mr. Chatterton was correct, namely, that the servants of the Gutta Percha Company, who were sent to the contractor's works to make the joints, were sent away because they made the joints too slowly?—I am not aware of it; certainly if I had been aware of it I should have done all in my power to prevent it."

Your obedient servant,

July 6, 1862. JOHN NELSON.

TELEGRAPHIC NEWS.

THE ELECTRIC AND INTERNATIONAL DRAMATIC CLUB.—The members of the above club intend giving an entertainment in aid of one of their sick members on the 14th proximo, at the Cabinet Theatre, King's Cross. The following pieces will be performed:—"The Rent Day," "Love in Humble Life," and "A Rough Diamond."

MAGNETIC TELEGRAPH COMPANY.—Mr. W. Wright, the winner of the London clerks' in charge challenge cup, having resigned that prize for further competition, a second handicap took place at Sydenham on Saturday last, which resulted as follows:—Chamberlain, 1st; Manning, 2nd; Wild, 3rd. Won by 1½ yards; Wild being beaten by a foot for second place.

TELEGRAPHY IN THE EAST.—Our own correspondent writes from Pera on the 22nd of June, as follows:—"Colonel Patrick Stewart is expected here about the 15th of July. Colonel Goldsmith, and Mr. Kersting, assistant superintendent, left Bagdad on the 19th of May on a semi-official tour of inspection of the Turkish lines between that place and Scutari. A Turkish engineer accompanies them. They are expected here about the beginning of August."

THE GLASGOW, CANTYRE, AND GENERAL TELEGRAPH COMPANY (LIMITED).—On the 16th of February last a public meeting of merchants, shipowners, &c., was held in the Underwriter's Room of the Royal Exchange, for the purpose of taking into consideration the scheme brought forward by Mr. John Kincaid to establish telegraphic communication between Glasgow, the Mull of Cantyre, and all intermediate places. After some discussion a committee was formed for the purpose of carrying out the object of the meeting; and since then Mr. N. Holmes, of the Universal Private Telegraph Company, has been indefatigable in his exertions to meet the wishes of the committee. We are now enabled to state that the undertaking has assumed a definite shape, and that a company has been formed, entitled, "The Glasgow, Cantyre, and General Telegraph Company (Limited)," for the purpose of carrying out the idea. We also understand that the new company has already received sufficient encouragement from the commercial public to induce them to enter into contracts for the formation of the line to Rothesay and Campbeltown, and in the course of three weeks it is confidently expected to be open to the former town, and by the middle of August to the latter. Starting from Glasgow, the line proceeds direct to Helensburgh, and, crossing the Gareloch at Row, it stretches from thence to Kilcreggan and on to Cove. Crossing Lochlong at the latter place, it proceeds by Blairmore round to Kilmun, and onwards by Loch Eck, crossing Lockfyne at Craigans, and from there to Inverary, and from Inverary down by Lochgilphead to Campbeltown. In order to connect Rothesay, a branch leaves the main line at Kilmun. Crossing the bridge there, it passes on to Dunoon, and onwards by Toward Point, where it crosses by a submarine wire from Ardine Point to Ardbeg, and on to Rothesay. It is also intended, we understand, to form a connection with Oban, either by way of Ardrishaig or Inverary. The above may properly be considered the commercial part of the undertaking; but another impotant feature is yet to be determined upon, viz., the extension of the line to Cumbrae, Pladda, Lamlash, and Cantyre Lighthouse, as explained by Mr. Kincaid at the public meeting referred to. This portion of the line will be most important to the shipping interest, because all vessels in distress, and in want of assistance, or wind-bound in Lamlash Bay, or in want of a tug-steamer, can easily telegraph from any of the above-named stations. It is a well-known fact to the Uunderwriters that ships with cargoes of great value have gone ashore on the Cantyre coast and become complete wrecks, although the circumstance was unknown in Glasgow for some days after the occurrence. With the telegraph in operation, it might reasonably be expected that assistance will at all times be forthcoming within a few hours, and through this means many lives and much valuable property may be saved. The telegraphing of inward bound American and other foreign steamers and sailing ships will also be of the utmost importance to all parties interested in them. It will also enable the proprietors of tugs to maintain constant communication with their boats at the various points of call. To effect these objects, and before proceeding with that portion of the undertaking, the company will require guarantees for three years from parties interested, that the revenue of this branch shall amount to a fair per centage on the capital expended. As this proposal seems perfectly reasonable in the circumstances, shipowners and others interested in the matter will no doubt see the propriety of making terms with the company without delay, as the work can be done at much less expense while the commercial portion of the line is in progress than it can be afterwards, if it is specially undertaken. We are glad to learn that the local authorities of Greenock have made arrangements with the company for the use of the telegraph, and that a reasonable guarantee has been given for the value of the service required. It must be a matter of much gratification to Mr. Kincaid to find that the scheme which he propounded upwards of eleven years ago, and which was then considered impracticable by many people, is now in a fair way of being realised.—*Glasgow Daily Herald.*

THE INDIAN LINE OF TELEGRAPH.—The special correspondent of the *Levant Herald*, writing from Bagdad, under date May 27, thus adverts to the condition of the Indian line of telegraph:—"The affairs of this important pashalic, at all times of great moment to Turkey, are rendered now additionally interesting to England and English readers by the fact of the new line of Indian telegraph passing through a considerable section of it. I regret, therefore, to have to report that the present state of things is eminently unsatisfactory; the construction of the telegraph is in consequence impeded, and it is doubtful when it may be resumed. The immediate cause of this untoward *imbroglio* is the disagreement of the Governor-General of Bagdad, Namyk Pasha, with the numerous and powerful tribe of Montefik, and the consequent revolt of the latter. They have been at issue for a long time, but the governor, at length, by way of humiliating the scheik, and weakening his *prestige*, decided to abolish the title of scheik altogether, and nominate him as *caimacam*. Upon this the seething dislike broke out into active and enraged hostility. When the governor saw the impolicy of the course taken with respect to the proposed infringement of the time-honoured dignity of scheik, he withdrew his order; but this was merely temporising. General belief here attributes the conduct of the governor, not so much to his own deliberate intention and resolve, as to the sinister recommendation of his *kehaja*, a local *mufti*, who unfortunately exercises great influence with the pasha. In withdrawing the order after it was once issued feebleness was evinced, and the next step showed corresponding rashness. Instead of resorting to and exhausting every possible means of conciliation the governor decided to send an armed expedition against the tribe. The expedition has accordingly set forth, and the conviction is here, that if it do not meet with disaster the victory it will reap will be but a barren one. The celebrated Ghiosukgli Reschid Pasha, when he was governor of this pashalic, waged against this same tribe a war of several years duration, but at length, notwithstanding his power and *prestige*, was obliged to resort to conciliatory measures in order to pacify and subjugate them. He found these the only efficacious means. The Montefiks are a powerful tribe, they can draw others to their standard, and the passage of the electric wire in their midst makes them additionally conscious of their importance and their power. Had the advice of the English Consul-General at Bagdad, Colonel Kemball, been listened to in this emergency, as it should have been, this difficulty might have been obviated; but his experienced and sound advice was not followed. The javelin is now thrown, and if the expedition fail the *prestige* of the Turkish Government will receive a rude shock, and a risk would be run of an insurrection at Bagdad. The obstinacy and ignorance of local pashas, the intrigues of their subordinates, the revolt of a powerful semi-Arab tribe, turbulent and warlike, although the scene be laid in the important and historic pashalic of Bagdad, are of moment only, people might generally say, to the Turkish Government, who rule, or should rule, the uneasy province. But as the theatre of disturbance is also the line of route of the Anglo-Indian telegraph, England is at the same time keenly concerned in the matter, and it should be made concise and clear to all whom it may concern. As the shortest route from Bussorah to Bagdad the line passes through the territory of the Montefik tribe; and if the construction of the line were left to the English managers and engineers there is not the shadow of a doubt but that the tribes would allow the works to proceed unmolested, and would aid, probably, rather than obstruct. But they will not allow the Turks to make the line, and Namyk Pasha, standing upon an airy and illusory pedestal of dignity, insists that, as it is in Turkish territory, Turks, and Turks only, shall construct it. The English undoubtedly are willing to subsidise the Arabs—but what matter? What possible injury could accrue to Turkey? None whatever. The greatest advantage, on the contrary—peace in her boundaries, and the orderly progress to rapid completion of one of the greatest international enterprises of the age. If the Turkish Governor of Bagdad were a man of cultivation, sense, and experience, instead of setting up at every moment, in season and out of season, an absurd affectation of dignity and authority, he would, like a sensible man, allow the English engineers to construct the line quietly. The Arabs would remain at peace, and a great end would be attained. In a word, the practical details must be left substantially in English hands, or the consequences will be inadequate and vexatious in the extreme. Meanwhile between Bussorah and Bagdad the Montefiks and the authorities are at open war, and there seems no probability of the line being completed through that tract of country until

autumn—if then. To rely upon the present line, therefore, as far as the disturbed territory in question is concerned, would never do. In the East, more perhaps than elsewhere, it is necessary to have two strings to your bow. Thus another line, of a more roundabout character, no doubt, but which will avoid the disturbed territory altogether, is in active process of construction. By a treaty between the Persian and English Goverments of October last it was decided that a line should be constructed by the Persian Government from Bushire, on the Persian Gulf, one of the landing points of the cable, viâ Kazeroon, Shiras, Movighant, Koomshah, Ispahan, Kashan, Koom, Tehran, Hamadan, Kermanshah, and Khanakeen, to Bagdad. The distance between Bushire and Khanakeen is about 1,100 miles. This line is expected to be open by the 1st of August next, but I much doubt whether the Ottoman Government will be ready by that time. There is nothing like a frank and sincere appeal to head-quarters. I wish the Porte would look to this. Instead of having an important district in turbulent revolt, and a great international undertaking checked and frustrated, by the peddling self-sufficiency and incompetence of a local magnate of an obsolete school, the most perfect peace might reign there, and the electric wire between Bussorah and Bagdad be in a condition to flash news to Constantinople, without interruption, before autumn sets in."

THE INTER-CONTINENTAL TELEGRAPH.—Subjoined is a communication regarding the above project, which appeared in the *Times* of the 4th inst. :—

"Sir,—In reference to the paragraph in your article of the 27th ult. on the question of the inter-colonial telegraph, will you permit me to say that the fact of a concession having been granted to Mr. Collins is somewhat doubtful. That the Russian Government are prepared to grant such a concession when the capital has been found I have every reason to believe, but it is absolutely necessary that some survey of the district through which the line is to pass should be made before any capitalists can be advised to risk their money in a project of, at present, doubtful aspect. A few years ago the engineer of the Russian Government in control of the telegraphs reported dead against the practicability of taking a line through the region north of the Amoor, on the ground that it would be impossible to maintain stations in such inhospitable regions (and that some few stations must be maintained can, I think, admit of no doubt), and he recommended that the route by the Aleutian islands should be adopted in order to reach the American continent. Since that time it would appear that the Russian Government have given up the idea of carrying this out, probably because their possessions in Russian America do not justify the outlay, but when we talk of constructing a line by this route it behoves us to take into consideration all the evidence hitherto collected on the subject. For myself, I am inclined to think that the line would offer fewer obstacles than some people anticipate, but I am bound to admit that those engineers who are opposed to its practicability advance reasons that are entitled to a hearing. Let us, in the interests of telegraphic progress, first demand such a survey of the north-east coast of Russia, and the north-west coast of America as may satisfy us of the practicability of the line, and then let Mr. Collins, or any one else, try and carry it out. As for speed, there is no reason why a message should take longer by this route than by the Atlantic (when laid), although, of course, the profit resulting from a message passing over 16,000 miles of wires, representing a capital of at least £2,000,000, must be somewhat less than that which will arise from the Atlantic line, supposing that it is successfully submerged next summer. Your obedient servant, C. E."

ANGLO-INDIAN TELEGRAPH.—With regard to the above line we find the following paragraph in the last *Bombay Gazette*:—" Up to the very moment when the ships of the Expedition dropped anchor off Fao, where the British portion of the telegraph to India terminates, Colonel Stewart confidently expected that he would immediately be in direct communication by telegraph with India on one side and England on the other,—such confidence did he feel that the important part of the operations for bringing this about, which had been entrusted to himself, had been efficiently executed; and so hopeful was he that, in view of the immense importance of the work, the Turks would for once have shown a little energy in doing their part, more especially as he knew that if they had only given a very moderate amount of assistance and support to the British officers and employés who had been sent to their aid, the work would almost have been done for them. But alas for faith, however weak, in anything Turkish! We might as well expect the leopard to change his spots, or the Ethiopean his skin, as the Turk to awake from the indolence and lethargy belonging to wasting muscles and loosening sinews which have fallen upon him in these later times. One part of Colonel Stewart's expectation was amply fulfilled: he did find himself in rapid and regular communication with India through the cable that had just been laid down; but when he hoped to be able to send on to England the news, not half an hour old, which had sped along it, he was filled with disappointment, for not only did nearly 200 miles of the Turkish line through Mesopotamia remain to be completed, but there seemed no hope that it could be completed for many months to come; and, moreover, a very important part of the line already erected by the Turkish Government between Bagdad and Constantinople was broken down to an unknown extent. Rebellion of the Arab tribes was the cause of these 200 miles in Mesopotamia remaining incomplete, and that rebellion was the result of the mistaken policy conceived by, and obstinately persisted in, in spite of repeated British warning as to the necessary result, by Namyk, the Pasha of Bagdad. His only course now is either to yield to the demands of the insurgents, which, indeed, do not seem to be very unreasonable, or else to crush them with overwhelming force, and maintain the supremacy thus regained (if that can be said to be regained which was never really possessed before) at the point of the bayonet. The former he may do—indeed, if he would have accepted advice from the British representative, Colonel Kemball, it might have been done long ago without any loss of dignity; the latter he cannot do, for though there is no lack of Turkish troops in the pashalik of Bagdad, yet they can scarcely be made available at a single point without exposing all the others to the dangers of revolt or invasion."

THE AMERICAN ARMY TELEGRAPH.—The correspondent of the *New York Times* gives the following account of the army telegraph:—"The wires of the army telegraph are insulated, and may be unrolled with great rapidity from a winch in a waggon constructed for the purpose. As the waggon moves forward, the wire is left to trail on the ground, or is placed upon light, portable poles, with pointed ends for thrusting into the soil, or is simply rested upon branches of trees by the roadside, as it threads its way through all the corps' head-quarters, and converges from every direction to the position of the general commanding. When the army moves, the wire is taken up by the winch just as quickly as it was laid, and is ready for use at the next stopping-place."

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF ASTRONOMICAL AND METEOROLOGICAL SCIENCE.—This new society is now completely organised, and in active operation, a cordial understanding existing between the president, M. Le Verrier, and the chiefs of Greenwich Observatory and the Meteorologic Office, in London. The following are the directors of the association:—Messieurs Le Verrier, Michel Chevalier, Le Doctor Conneau, Glais-Bizom, Payon, Vicomte de Vougy, Belgrand, L. Moucher, Serret, d'Abbadie, Baron, Barral, Marié, Davy, Renon, A. Sanson, Gaillot, et Wolf. The first meeting of the society took place a short time since, when the chair was occupied by M. Le Verrier, the director of the Imperial Observatory, who was supported by Dr. Conneau, and M. Glais-Bizom, as vice-presidents. Just as business was about to commence, a telegraphic message was received from St. Petersburg, congratulating the new association on its formation and first meeting. M. Le Verrier addressed the associated members on the present desiderata in astronomical science, the proposed establishment of observatories in the principal towns in the south of France, the services rendered to navigation by meteorological telegraphy, and those which it may render to agriculture. M. Renon, the secretary of the Meteorological Society of France, presented a report on the prizes to be offered in meteorology, which are as follows:—A grand prize of the value of 4,000f. for the best general memoir, printed or written, in French or any other language, on the general movements of the atmosphere, with the view to the foretelling of tempests; the memoirs to be sent to the secretary of the association, at the Imperial Observatory, Paris, before the 31st December, 1865; three prizes of 500f. each, for observations made in places little known in that respect, or taken at sea; these to be sent to the association before the close of the present year. Models and portions of the great telescope, now being constructed for the association by M. Léon Foucault, were exhibited, together with the fine block of glass destined to be employed in the formation of the great lens.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good	2/2 to 2/6 per lb.

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Para, first quality	1/9 to 1/10	„
second „	1/6 to 1/7	„
third Negro-head	1/2 to —	„
Java and Penang	1/4 to 1/5	„

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	102 to 105	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{3}{4}$ to $\frac{1}{4}$ dis.	—

TO CORRESPONDENTS.

O. K.—Consult some *independent* telegraph engineer or electrician.

P. L. S.—Send a description and specimen of your cable, and your wishes shall be complied with.

J. YOUNG.—The communication to which you refer was consigned to our waste-paper basket some time ago; had we published the same it would have proved a sad reflection upon the judgment of the committee which you essayed to defend.

A SUBSCRIBER.—We thank you very sincerely for your interesting contribution. Our columns are open to fair criticism. We are not wedded to either gutta-percha, india-rubber, or balata, but will always be happy to assist in promoting the adoption of any material of acknowledged merit.

THE TELEGRAPHIC JOURNAL.

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ANGLO-INDIAN TELEGRAPH.

THE insurrection of the Montefic Arabs is now entirely quelled, and the state of the disturbed district between Diwanyeh and Korneh is now such that the telegraphic works can be resumed, but it will not be possible to make much progress until the autumn, as the men can do very little work during the present hot and unhealthy season. Colonel Goldsmid arrived at Mosul (the site of the ancient city of Nineveh) early last month, on his way to Constantinople to report on the condition of the line through Asia Minor. He will then meet Colonel Stewart, C.B., who left Bombay by the mail of the 24th June. It is earnestly to be hoped that strenuous exertions will be made by the Government to provide a proper service of English clerks at the chief stations between Scutari and Fao, without which it is utterly impossible that the enormous commercial traffic which may be looked for directly the Anglo-Indian line is opened can be efficiently performed. The technical character of the messages between merchants in this country and India, the quotation of prices of various kinds of stock and goods, the names of vessels, and many other details which will naturally occur to any one accustomed to the daily routine of a telegraphic instrument room, will otherwise be so mangled in transmission as to render the line more an agent of confusion than of utility, and the result of a bad beginning will retard the advance of the traffic afterwards more than the Turkish Government (who are so largely interested in obtaining good returns) can probably conceive.

By far the greater part of the messages will be in the English language; and it is absurd to suppose that any Turkish official, however much he may have studied it, can master the names and expressions of mercantile dealings sufficiently to cope with the business in a satisfactory manner.

The Persian line between Teheran, Ispahan, Shiraz, and Bushire, is proceeding rapidly, and will most likely be (in connection with the Russian line *viâ* Tiflis and Tabriz) the first by which the Persian Gulf cable is worked through to India.

FORCE AND FORM.

CONTRIBUTED BY B. M.

II.

THIS view of matter, as force in a form, no doubt will be called visionary and fanciful, but there are fewer assumptions by far in this than in any other yet propounded. It cannot be said to be absolutely new, for it is at least a century old; but of course it is comparatively new when compared to the generally-received theory, namely,—the hard, unyielding particle, which is neither compressible, expansible, nor divisible, in fact is unalterable, according to the theory. Of course each particle, according to its kind, must have a certain size and form to be a finite entity at all. It is easily perceived how this theory has grown up out of our sensations, with some slight shaping by the intellect from time to time. A stone is hard to the touch, even of a savage, and if he can be supposed to speculate about the ultimates of matter, he would arrive at them by the simplest means, namely, by division, and when he had divided the supposed stone into the smallest portions possible, either in fact or imagination, he would say there is your ultimate particle, and he would be just saying what our philosophers have said, and are saying. That being done, then, as the necessities of the case arose, these particles could be endowed with properties to suit all circumstances, such as attraction and repulsion, difference of shape and size, &c. If angular, they would become solids; if spherical, they would become fluids of the most mobile kind, and with due admixture, liquids of every degree of limpidity, and so on as every new condition arose, a new supposition. But can that be called a theory out of which nothing spontaneously grows? It looks like a patchwork of after-thoughts; there is no prevoyance whatever; yet this is our present theory of matter. Certainly it is the first rude beginning of a theory which must be pruned and dressed into shape, and cultivated into life by experience.

But it is said, "the atomic theory must be true, for see what results have grown out of it in chemistry!" This is an error. The theory of chemical equivalents has nothing whatever to do with the ultimate particles or atoms of matter.

The theory of the ultimates of matter can be ignored altogether, yet that of chemical equivalents will stand good; for it is simply quantitative, and has nothing to do with ultimates at all. Let us take this ultimate particle or atom as at present understood, and see what of reason we can get out of it. It is a little unchangeable, impenetrable piece of matter, with an atmosphere of force around it. Let us take the nucleus first, an unchangeable, impenetrable piece of matter. Now to be matter at all it must have length, breadth, and thickness, and then follows the necessity that, however small it may be supposed to be, it can be halved. All that can be said to this is, that by this supposition it is unchangeable; but I answer, your supposition is untenable then, for it can only be based on this, that an ultimate atom is the hardest thing in nature, and therefore, if even we had senses and instruments fine enough, we could not find a material hard enough to divide it; but do we not divide diamond, which is the hardest material we know of; and if diamond will cut diamond, why should not atom cut atom? But I hold it to be untenable on another ground. I take it as an axiom, that whatever reason shows to be possible, *is possible;* therefore your ultimate particle can be divided *ad infinitum*, which makes it no ultimate particle at all. Now let us take the surrounding atmosphere of force, which is added to this hard nucleus to make an atom. An atmosphere of force. What is force? Simply that which is always producing motion, or in effort to produce it. Then how can a force exist without a contenant? It cannot exist at all: it would be simply dissipated, annihilated. Then this atmosphere of power or force must of necessity have a bounding form, or annihilation ensues from the very nature of force, which is perpetual activity or effort, and without a contenant would be perpetual activity to infinity; but that is not possible, for the forces we are treating of are finite, for they pertain to finite matter, therefore each force must have its limit of potency, and if a limit of potency, then *there* will be its bounding form, consequently every force must of necessity have its bounding form. But we have seen that the hard nucleus inside this atmosphere of force approaches to the vanishing point by simple division, let it then vanish, and what have we: simply *force in a form.* Now what have we lost by expelling this piece of hard, untractable brute matter, which is the only piece of dead, inert matter that I know of. Let it go. There is one obstacle less to our understanding this living and moving world of matter, and the higher lives that breathe through it.

Now let us examine the atom we have obtained by this sublimation. *A force in a form.* A simple force in a form must of necessity be dynamic, it can only become static by being opposed by an equal force, neutralizing it, and of course it is simple force in a form, without complications, that we must first consider; then that form must be the form of its motion, which in this case will be a simple sphere of potency, whose centre is its starting-point from within and its termination from without. A point then is the nisus of all motion, and consequently of all force. This hardly needs to be stated, for every one sees that all motion must start from a point, and end in a point. What says geometry? The science of mechanical forms; the first and simplest of all sciences, consequently the most perfected; it says that all figures and forms have their origin in a point: point, line, surface, full form; and moreover it says, that a line is produced by the motion of a point, a surface by the motion of a line, and a solid by the motion of a surface. This is a mechanical way of stating it, certainly, but geometry is the science of mechanics, which deals much in straight lines, but nature sparingly, if at all. Form has been known these many centuries to have its origin in a point; yes, even before the old school-master, Euclid, wrote about it; and to me it is as clear, that force also begins in a point, and if you say it is not so, then show me how it can be otherwise; till then I shall take it as proved. What becomes of the objection so fatal to the hard nucleus? You cannot divide our atom; it is a force in act, whose centre of potency is a point, and limit of potency its form; you cannot divide it unless you divide it in its perpetual origin, which is a point; but from the nature of a point, that is not possible. But by the induction of other forces there may be less or more of activity and consequent increase or diminution in our atom; but this is claimed for the atmosphere of the atom with the hard nucleus, else there could be no such thing as expansion or contraction in matter.

But matter and force, according to the present theory, are considered two separate and distinct things. We, on the contrary, consider force the essence of matter, and that the form of this force gives matter all its properties, discernible to the eye, and many to the touch. This is a wide difference, and one pregnant with many results, and especially to the better understanding of electricity and magnetism, and from these the greater part of our confirmations by experience will be brought, as to the forms of motion and many other particulars.

We will enumerate some of the known forces, to show by this theory how they act and re-act on each other in spheres and cyles, and to show that all matter is simply forces in static form, and that it is not made up of hard, unalterable, dead atoms, with force superadded. The forces we would name are these: attraction of cohesion, chemical affinity, gravity, heat, light, electricity, and magnetism. Attraction of cohesion is the drawing together of like to like; but chemical affinity is the drawing together of dissimilars; therefore, the resultant is altogether different to either of the forces uniting; as is shown in all chemical compounds. Gravity is the general sphere, which includes at least the foregoing, and seems to be in the inverse ratio of the activity of the combinations of atoms concerned; for if a substance be condensed or compressed, it retains absolutely the same gravity as it possessed before condensation or compression; but is relatively to bulk of greater gravity than before, and has given out some force, equivalent to the force applied, and has produced in lieu thereof a like equivalent of heat, and that force cannot be again restored, so far as we know, but by the application of a like amount of heat.

We speak of attraction and repulsion very glibly, as if after having said these words we knew all about what we meant by them; but it appears to me that we do not even give ourselves the trouble to try to know what we are meaning. Of course we can say, and do say, that attraction means a drawing to, and repulsion a thrusting away from; but that is just, in effect, saying nothing. The thing we really do want to know is, how can two things attract each other, for it is always mutual. Can we reduce it to some mechanical form, that it may be made understandable? for down to that sphere all things must be brought if we are thoroughly to comprehend them, for in it we live, and move, and have our being. What then is the how of this thing? Does it take place at a distance without anything intervening, or must there be a medium? Is it in straight lines, or in simple curves, or in spirals?

When one sets oneself seriously to think about it, one cannot imagine, that it can take place at a distance, for that would be obtaining an end without the means of a nexus; therefore there must at least be a medium. Then how can it be comprehended that two things can approach each other in a straight line by means of an inherent force in each? That they could be projected against each other by forces external to each in a straight line, may easily be comprehended, but not mutually drawn by their inherent forces. A simple curve is under the same difficulty of comprehension; but I think not so a spiral.

THE PREVENTION OF OUTRAGES IN RAILWAY CARRIAGES.

NEVER since the introduction of railways has the press recorded so many fearful misadventures as have occurred to passengers within the past twelve months. It is but a short time ago that all England was startled by the story of a desperate encounter with a maniac, in which inoffensive travellers were only spared merciless death by force of numbers. Since that date scarcely a day has passed without outrages of some kind having been attempted on lonely women travelling by the rail. Now it is our painful duty to chronicle one of the most barbarous murders on the North London Railway that ever disgraced the annals of a civilised country. On Saturday, the 9th instant, about three o'clock in the afternoon, Mr. Thomas Briggs, a gentleman sixty-nine years of age, well known in City circles, having for many years been connected with the banking establishment of Messrs. Robarts, Curtis, & Co., left the bank for the day, and proceeded to his niece's residence in Nelson-square, Peckham, where he dined. There he remained until half-past eight o'clock, and was seen into an omnibus in the Old Kent-road by the husband of the niece, Mr. Buckham, who parted from him in his usual good health and spirits. Before leaving he intimated that he would proceed to the City, and then take the train from Fenchurch-street Station for Hackney. He was almost a daily traveller on the line, and was well known by the railway servants. From the time of his getting into the omnibus in the Old Kent-road until his body was discovered on the line of the North London Railway nothing has been gleaned of his movements, or whether any one was in his company. At a quarter or twenty minutes past ten o'clock on Saturday evening, on the arrival at Hackney of the 9.45 train from Fenchurch-street Station, a gentleman called the attention of the guard to the state of a compartment of a first-class carriage (No. 69) in the train. He had opened the door at Hackney with the intention of getting in, and had placed his hand on one of the cushions, which he found to be covered with blood. The guard, on looking in, found such to be the fact. Not only were the cushions, but the floor, sides, and window were besmeared with blood; in some places there were pools. He also found inside the carriage a gentleman's hat, a walking stick, and a small leather bag. The guard at once took charge of the articles, and locked the door. Some ladies who were in the adjoining compartment noticed to the guard the circumstance that some blood had been spurted through the carriage window on to their dresses as the train came from Bow. The

guard at once telegraphed the discovery to Mr. Kebble, the station-master at Bow, and at the time an impression was entertained that some one had committed suicide, and had thrown himself out of the window of the carriage on to the line. About the same time that the above discovery was made, the driver and stoker of an engine which had been working the Hackney-wick and Stratford traffic, and which was returning from the Wick Station to the Bow locomotive works of the North London Railway, as they were approaching the railway-bridge over Ducket's Canal saw something lying on the six-feet way—the space between the up and down line. At first the driver thought it was a dog, but the stoker judged it to be a human being. The engine was stopped, and the stoker got down and went back along the line with a lamp. On coming up to the spot he discovered the body of a gentleman, saturated in blood, and apparently dead. A brutal murder had been committed, and the perpetrators of the atrocious crime have hitherto eluded the vigilance of the authorities.

The frequent occurrence of assaults and outrages in railway carriages has rendered travelling dangerous, and unless some means are speedily adopted whereby greater security can be ensured to passengers, the usefulness of our great locomotive highways will be seriously impaired. On the American, French, and Belgian railways the guards are able to pass up and down or through the trains, and to render any assistance that may be required; but on the English lines no system of communication exists between the passenger and the guard or driver. To this circumstance may be ascribed the many evils of which we complain. Communication there must be between caged-up *voyageurs* in a railway car and the official in charge. It is no longer to be tolerated that the honour of women is to be assailed, and the lives of venerable men to be sacrificed to the highwayman, because railway companies will not effect modern improvements in their rolling stock. At the present time our railway carriages possibly offer facilities to the criminal; and now that the work of the desperado has been begun, we cannot, considering the contagious character of vice, suppose that we have heard the last of these outrages.

It therefore becomes a matter of great importance that measures should be devised for the better security of railway travellers. On reference to another portion of our columns it will be seen that this subject is being debated in the daily press. All the writers agree that some system of communication between the guard and the passenger should be established. Various are the means proposed to attain this object: some of them are identical with the plan advocated by Mr. Owen Rowland in the *Mechanics' Magazine*, the *Railway Record*, and other papers, in 1846; but all of them prove immeasurably inapplicable when compared with the electric bell. There are many electrical inventions at the service of railway directors, but they will not be impressed into the service until some appalling catastrophe induces the public to demand their application. Electric bells are now employed in all the large hotels on the continent, and are being gradually adopted in this country. Their extreme simplicity and utility, and the innumerable purposes to which they can be applied, induce us to urge their employment as a means of signalling from the carriage to the guard of a train. It may be asking too much that the rolling stock of railway companies shall be altered, and made like that in use on continental lines; but we demand that, if it be impracticable to adopt a system whereby passengers will be able to summon immediate aid in case of danger, means be employed to enable the traveller to indicate to the guard of a railway train that his presence is required in a certain carriage so soon as it is possible to bring the train to a standstill. Were the electric wire employed it would be simply necessary to touch a button or a spring to effect the desired signal. In the adoption of this plan there are no mechanical difficulties to be overcome, no machinery to become deranged. A trifling outlay would thus establish a deterrent to the vicious, and a protection to the peaceful traveller, without impairing the value of the rolling stock. It has been alleged that a system of communication with the guard in charge of a train would prove an inducement to certain of the *genus homo* to complain of the most trivial circumstances, and thus occasion delay on a journey, and interfere with the regular working of the traffic. These objections are fallacious, and are advanced more in palliation of the tardiness of railway directors to effect improvements or alterations, than from fear of ungrounded complaints. The safety of the passenger from accident by the rail, or outrage on the rail, can be ensured by the adoption of adequate precautionary measures, and we hold the company culpable that neglects to afford all possible security to those who entrust their lives in the tearing, rattling team. The occurrence of Saturday last has created a painful sensation throughout the country. It is felt that the fate of the revered gentlemen, who was so barbarously destroyed when on the verge of three score years and ten, possibly awaits others. A common danger has been recognised; and it is the duty of all railway companies to, so far as practicable, avert the recurrence of these terrible atrocities.

A FRIENDLY SUGGESTION.

The main object of the managers of joint-stock companies, with few exceptions, is to obtain the largest possible dividend for shareholders. The disposition of the commercial world, in the eager struggle for wealth, is to set aside the claims to consideration and sympathy of those who possess no other privilege than that of working for a mere pittance. This leads to a condition in which the reciprocal interests of employer and employé become ignored; and from this state of indifference there is no appeal but to the consciences of those in whose power it is to induce a better state of things. It may, therefore, be in season to bring to mind a time-honoured custom which is calculated to counteract this tendency. Work, unrelieved by recreation, impairs the physical and mental energies of the human race, rendering the being unfit to perform efficiently his or her social obligations, and prematurely destroying the constitution so beautifully and wonderfully made. There are no harder working people on the face of the earth than the English; and no class of this people so many hours per diem employed as those engaged in telegraphy. Their labour is (pardon the paradox) constantly intermittent, and their opportunities for relaxation accordingly limited. Let any one who doubts the truthfulness of these observations visit the establishment of any telegraph company, and the appearance of pale, worn, sickly, stived-up manipulators will attest the statement. It is on behalf of these—the least in the employ of telegraph companies, if we may judge by the consideration they receive—that we have a word to say.

Nothing can be more desirable than that the great gulf which has hitherto separated the employer from the employé should be spanned by a viaduct of cordiality. No combination of circumstances has tended to effect this object so fully as the Volunteer movement. Here men of all grades and positions in society meet on an equal footing for a common purpose: the exercise to all is the same; the instructions, or, rather, the commands are given alike to patricians and plebeians, while the penalties for any breach of the regulations or neglect of duty admit of no distinction. Here the fraternal condition is fully realised; and we have yet to learn that any evil consequences have arisen upon this departure from the traditions which have so long prevailed, setting class against class, and rendering exclusive the intercourse of those occupying exalted positions in society. It has been urged when these views have been enunciated in the presence of persons possessing but

a limited knowledge of human nature (though the objection is as old as the hills) that familiarity induces a condition at variance with proper discipline. The fallacy of this plea has been met by a reference to the efficiency which the new national force has attained. We are anxious to extend the principle of cordiality between persons engaged in different branches of the telegraphic art, and to promote a more general intercourse between the principal and subordinate officers in the telegraph service. How is this to be effected? Not by unreasonable demands on the one part to be met by peremptory refusals on the other; rather by the patient consideration of the respective positions. It is not within our province to indicate any particular course of action—the means to be employed can be best determined according to locality and circumstances; but we have no hesitation in recommending for adoption the practices of other sections of the community, where they appear likely to conduce to the end in view.

It is customary in large manufacturing and other establishments for employers and employés to have an "outing" at least once a year. In the several trades these trips are variously denominated: the "bean feast," the "wayzgoose," the "annual excursion," are only different terms to express one and the same thing. These affairs generally prove a source of unmixed gratification to all who participate in them. Would the reader know the character of these gatherings? They generally comprise a trip to some rural spot by one of the many means of transit available to the public—a pleasure in itself. Arrived at the locality previously indicated, a well-spread table awaits the excursionists, at which the principal of the establishment or the head of the firm usually presides. When the temporal necessities of the party have been duly ministered to, the usual loyal toasts and pledges are given, which affords occasion for the expression of sentiment, and never fails to exercise a salutary influence. The employer avails himself of the opportunity to discourse kind words—they cost little, but are very valuable—and is met with expressions of regard or with tributes of gratitude from his employés, which not unfrequently show to each their mutual dependence, and tend more than anything else we know of to promote good feeling and harmony. The remaining portion of the day, perhaps, is spent in the enjoyment afforded by the sports of the field, boating, &c. The days of riotous and drunken revelry are over. No violations of peace or order occur, and all return to their ordinary avocations on the morrow wiser and better men.

This good custom has not yet met with recognition in the telegraph service. We have recorded several trips and holidays of clerks in telegraph companies, but these have been notable for the absence of those whose presence—not patronage—would have been a source of satisfaction, and would have given vitality to the proceedings. Even sheep like to hear the shepherd's voice. How much more, then, do men desire to be occasionally brought within the personal influence of those who are called upon to rule over them? Once a year, at any rate, the reserve and *haut-ton* of office might be cast aside, and directors, secretary, manager, engineer, and electrician might meet the humble workers in the same undertaking with beneficial results. Interchange of thought and feeling is productive of great good, and whoever ignores its advantages isolates himself from society, not without paying a heavy penalty for his folly. The officer (who cannot understand what clerks want holidays for, but who takes his two months' tour on the Continent every summer) may express the utmost contempt for the sentiments we have enunciated—may raise the shadows of objections, alleging the impracticability of these suggestions, urging that they are Utopian and unworthy of further consideration—but we leave the major portion of our readers to judge the value of our remarks, and to supplement our efforts at the board meeting, or otherwise, as opportunity offers. In this matter we must not be understood to advocate the patronage by one class in order to effect the degradation of the other; on the contrary, we insist that there are duties and responsibilities attaching to both the employer and the employé (and the superior officers in joint-stock concerns may be considered in the position of the former) which will in good time be fully acknowledged. In the meanwhile it will be well to perpetuate the custom to which we have adverted. We are not saying too much when we affirm that many orderly-minded men of means esteem it a privilege to invite their "hands" (we use conventional language, in which heads and hearts are never taken into account,) to an annual merry-making, and highly value a hearty response. Telegraphy is now a craft, and there is no reason why the practices of other businesses should not be adopted by those engaged in the transmission of intelligence. We commend this subject to the consideration of the directors and shareholders of our large telegraph companies; and whenever we learn that our recommendations are about to be realised we will undertake to give due publicity to the proceedings in these columns.

SMITH'S ELECTRIC TELL-TALE.

THE ordinary tell-tale or "pin" clock, although it secures the vigilance of a watchman in one portion of the building, cannot do more. It certainly cannot inform the master whether or not the man has gone his nightly rounds as he ought. That he has been watchful and attentive in any one hour is all that one clock can prove, and the employment of two or more is rather too costly an expedient to prove very popular. The accompanying engravings give an external elevation of a very simple and ingenious tell-tale, invented by Mr. Willoughby Smith, electrician to the Gutta-Percha Company, and manufactured by Mr. J Sax, of 108, Great Russell-street, Bedford-square. The principle of its action is simply this:—Let us suppose that in different parts of a large establishment, instead of expensive clocks, a number of old-fashioned hour-glasses were placed; let us suppose, further, that the watchman in going his rounds should turn all these glasses within the hour. It is obvious that, if any means could be devised by which the turning of each glass before it was run out could be registered, all the purposes of the best watchman's clock would be fulfilled. This registration is exactly what Messrs. Smith & Sax effect, but the registration takes place in the head office of the firm, and it is matter of impossibility in consequence to tamper with the record.

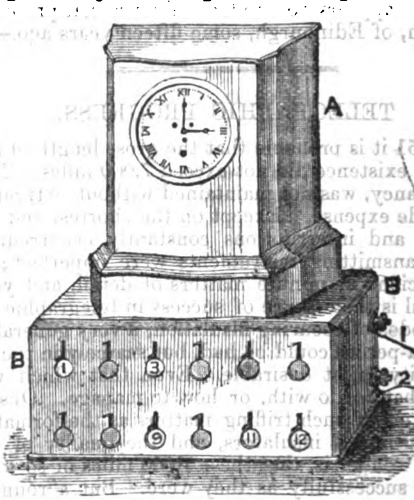

FIG. 1.

An apparatus is affixed to an ordinary clock, A, Fig. 1, so constructed as to communicate by means of electricity with certain small boxes, one of which is shown in Fig. 2, placed in different apartments or districts of a building requiring to be visited. The watchman is provided with a small key, by means of which he sets the sand-glasses each hour; by so doing he completes a circuit which would otherwise be broken by the ascent of the glass from an inclined to a vertical position, by the change in the position of

the centre of gravity, consequent on the fall of the entire quantity of sand into the lower glass.

Beneath the clock is placed a stand or base, B, Fig. 1, in the lower part of which are twelve apertures corresponding to the hours, marked on the dial above. In each of these is placed a small German silver slide, marked 1, 5, 10, &c., up to 12. The clock is placed in the master's private office, and the operation is as follows:—So long as the line is complete a label will drop into view as the hour-hand of the clock reaches each figure on the dial; but the circuit cannot be kept complete unless the hour-glasses, which are shut up in locked boxes, are turned regularly; thus the neglect of any one hour is registered by the non-descent of the corresponding label. It matters not if out of twenty glasses nineteen are in contact. The failure of the twentieth is inevitably registered.

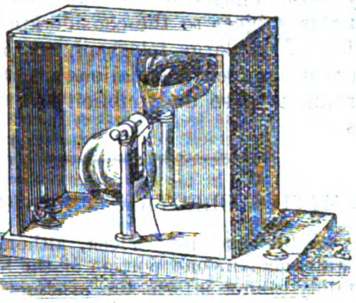

FIG. 2.

If the wires are tampered with, a bell is set ringing in the office until attention is attracted and the wires set right.

When desirable alarums can be rung at various hours, or at the same hour in many different rooms by the same clock. Thus, if need be, an entire village of factory operatives might be aroused betimes. It is evident that this electrical tell-tale is applicable to a vast number of purposes. It can be used on board ship; at railway-stations it can report the vigilance of outlying signal-men. In fire-engine stations, breweries, factories, mills, docks, or warehouses, it is likely to prove equally suitable.

[We are indebted to the *Mechanics' Magazine* for the above description, and to Mr. Sax for the blocks to illustrate the same; but we shall defer any expression of opinion concerning the utility of the instrument until we have had opportunity of examining it in operation. The idea of employing the hour-glass, in conjunction with electricity, for a registering tell-tale, is by no means novel; indeed the plan appears to us identical with that proposed by Mr. Alexander Bain, of Edinburgh, some fifteen years ago.—ED. *T. J.*]

TELEGRAPHIC PROGRESS.

IN the year 1851 it is probable that the gross length of all the telegraph lines in existence did not exceed 7,000 miles. The system, then in its infancy, was not maintained without extreme difficulty and considerable expense. Except on the shortest and most direct routes failures and interruptions constantly occurred. Both receiving and transmitting instruments were imperfect; as a rule, they were deficient in minute matters of detail, and yet the perfection of detail is the essence of success in telegraphic operations. Of the best modes of securing insulation, a very general ignorance existed. Gutta-percha could be had, but scarcely in the quantities, or of the quality, most desirable. Even that which we had we hardly knew what to do with, or how to manage. Obstacles were encountered even in such trifling matters as the formation of post lines, the procuring of insulators, and the quality of wire. The only matter of wonder is, that these 7,000 miles or so were worked as well and as successfully as they were. But a round dozen of years has elapsed since 1851, and each and all of these years have been marked by progress. In this matter of telegraphic communication by the aid of electricity the world has never retrograded a single step. There may have been delay, failure, mischance; but, nevertheless, we have gone onwards. The importance of the ends to be gained, the advantages to be derived, were too great to permit a moment's hesitation. Electrician has succeeded electrician, each taking up discovery where his fellow left off. And we thus find that that thing which first had existence in the minds of a few obscure labourers in the field of science now engrosses the attention, not alone of men or of companies, but of entire nations. Over 160,000 miles of telegraph lines now have existence, and it is not easy to find a corner of the earth from which we may not flash back intelligence to countries divided from us by thousands of miles. But great as this distance is, there is every probability that in a few years it will come to be regarded as comparatively insignificant. In spite of piteous wars and rumours of wars, nations in this matter have acted the better part; and so we find that the endeavour to facilitate communication by the establishment of new lines is heartily entered into by every civilized people without exception; while those which are not civilized either stand by and watch without opposing the operations of those who are, or, in their very ignorance, are content to submit to their dictation; and perhaps aid—certainly do not hinder—the gradual extension of the all-pervading wire.

A mere glance at the projects for inter-continental telegraph lines entertained at the present moment by the principal Governments is enough to prove how universal is the interest felt, how vast are the schemes proposed. The construction of the proposed line which, viâ Behring's Straits, will complete the circuit of the world, has lately been made the subject of earnest discussion in the New York Chamber of Commerce, and as the statements then put forward were elaborate, exact, and as authentic as anything well can be, we cannot do better, perhaps, than select from them the most remarkable facts.

It appears that Russia has undertaken the construction of a line of 6,000 miles from Moscow to the Pacific Ocean, at the mouth of the Amoor. Of this distance, 4,000 miles of line, from Moscow to Irkutsk, are in operation. Mr. P. M. Collins, of New York, has obtained a concession from the Emperor of 33 years to extend this line up to and across Behring's Straits, and from thence to the frontier of the British possessions—a distance in all of about 4,500 miles. The British Government have granted a similar privilege for the extension of the line down the Northern frontier of the United States, and an application for a like concession from the American Government has been laid before the Washington Congress. Thus will the telegraph systems of Europe and Asia be made one with that of America. The Chamber of Commerce unanimously resolved to memorialise the President and both Houses of Congress in favour of the undertaking. It is stated on good authority that the entire work of construction can be completed in three years. Behring's Straits are about 39 miles wide, and not more than 150 feet deep. The entire length of the completed line will be about 16,000 miles, and American telegraphists state that during the present year messages have been sent from Boston to San Francisco, a distance of 3,000 miles, in two minutes. Whether this has been a strictly exceptional effort or not does not appear. The fact of its being so would in no way detract from the value of the lesson taught.

The American Secretary, Mr. Seward, in the course of a report on Mr. Collins's scheme, recently laid before a Committee of the Senate, states that throughout that gentleman's negociations with the Russian and British Governments for leave to pass through their American possessions, he has been acting under the instructions of the American Government, and that his application to the Congress for a right of way across the public lands and the use of a national vessel is reasonable. Mr. Seward proceeds to say that the line which the Russian Government is constructing, or has undertaken to construct, from St. Petersburg to the mouth of the Amoor, is but a small part of the stupendous work which the Emperor has begun. His Imperial Majesty's design embraces also a telegraphic wire from the mouth of the Amoor, over the islands of Sakhalin and Jerro to Jeddo; also, from the Amoor, along the bank of the Usuri, to Viadi Vostok, on the coast of Tartary, Viadi Vostok being selected by the Emperor for his naval station on the Pacific coast; also a wire from the Irkutsk telegraphic line, through the vast territory of the Mongols, to Pekin; and American citizens in China are soliciting, with good prospect of success, permission from the Chinese Government to extend this line to Nankin, Shanghai, Amoy, and Canton. The Russian scheme comprises a wire from the main Continental-Russian line at Omsk, near the southern boundary of Asiatic Russia, through Mongolia, China, Turkestan, Bokhara, and Cabool, to meet the telegraphic system of India in the Punjaub, and connect it with Europe; and also a wire from Kazan on the main central Russian line, passing along the shore of the Caspian Sea to Teheran, and along the banks of the Euphrates to the Persian Gulf, there to be connected with the telegraphic system of India.

It will be seen from this that nearly every nation on the face of

the earth will be placed in direct communication with every other, if the Russian scheme is carried out, save Australia. Here, however, English enterprise takes the matter up. Already we are in communication with Bagdad, and ere long, it is probable that a line will be fully established between this town and Kurrachee, a distance of 1,410 miles. The Indian Government has consented to subsidise a line from Rangoon to Singapore, a distance of 1,090 nautical miles. In less than two years the Dutch Government will have fully established communication between Singapore and Batavia, and so, in connection with existing land lines, to the east end of Java. A glance at the map will show that the distance to be traversed between Australia and Asia presents no very alarming obstacles; and we may safely say that the day is not very distant when Melbourne will be in telegraphic communication with London, New York, or St. Petersburg. The establishment of an Atlantic cable between Cape Clear and Cape Race is only wanting to complete, at this moment, a telegraphic circuit round the world between 42° and 65° north latitude, and no man living can say how soon this line may be duplicated or tripled.—*Mechanics' Magazine.*

REPORT OF THE ASTRONOMER-ROYAL TO THE BOARD OF VISITORS OF THE ROYAL OBSERVATORY, GREENWICH.*

WE have to thank the Astronomer-Royal for a copy of his important and valuable Report. Amongst our subscribers there are many who will approve of a portion of our columns being devoted to the diffusion of such knowledge as the Report contains, especially that part which relates to electric and magnetic phenomena.

It has been my rule, in framing my Reports to the Board of Visitors for several years past, to adapt them to periods bounded at the beginning and at the end either by the beginning or by the middle of a lunation. The Report which I have the honour now to place before the Board applies to the period of twelve and a-half lunations, from May 17, 1863, to May 20, 1864.

I. Buildings and Grounds.—Only one change has been made in the astronomical buildings. It had long been remarked that the ventilation of the south dome (in which the altazimuth is mounted) was insufficient. I have therefore opened two windows into the room, one on the south and one on the east side. The south window is not often used, and is in fact at the present time blocked by a shutter; but the east window is almost perpetually open, partly by understood regulation and partly because the external thermometer is fixed without it; and the temperature of the room is now in an excellent state.

The north dome (formerly called the east dome or north-east dome) does not exclude the rain so perfectly as it ought. Instructions have been given to the proper workmen for its examination, and it may possibly be made water-tight by the time of the meeting of the Board.

Two piers have been built in the front court for the support of instruments which I expect Mr. Otto Struve to bring, to be used in observations connected with the Great Arc of Parallel. It was necessary to dig to the depth of 12 feet, to obtain a satisfactory foundation for the piers. A portable observatory is to be erected over them in some part of the approaching summer.

In a very heavy squall which occurred in the gale of December 2 of last year, the stay of the lofty iron pillar outside of the Park rails, which carried our telegraph-wires, gave way, and the pillar and the whole system of wires fell. By permission of the Department of Her Majesty's parks and public buildings, I was enabled to select a new position within the park, and thus, to attach the wires to a much shorter wooden mast. On the last day of the year, communication was again made perfect.

An important alteration has been made in the Magnetic Observatory. For several years past, various plans have been under consideration for preventing large changes of temperature in the room which contains the magnetic instruments. At length, I determined to excavate a subterraneous room or cellar under the original room. The work was begun in the last week of January, and in all important points it is now finished. The ground was cut down on all sides in the plane of the inner surface of the former walls, and within this space a 9-inch wall was built all round, so that the transverse dimensions of the room are less by 18 inches than those of the former room. Bricks were selected which were almost free from magnetism. The room is illuminated when necessary by three well-windows, facing the south; these can be covered by yellow glass, or by wooden shutters, and can otherwise be blocked. It can be warmed by a gas-stove, and lighted by gas-lights. Ventilation is provided by a large copper pipe leading to the ventilating-cowl of the upper room (no longer required for the upper room), through which pipe the warm stove-pipe is led nearly to the top. Drainage is effected by a pump in the ground outside of the building, about 20 feet distant from the eastern arm of the building. The building has been somewhat delayed by the illness of the Superintendent of Works, and also by the circumstance that the walls dry slowly. The reading of the atmospheric dew-point, at this season, is sometimes higher than the mean temperature of the ground, which is the temperature of the walls. It seems probable that the stove will be required more frequently in summer than in winter. On the erections for carrying the instruments, I shall speak hereafter.

The map of the grounds and buildings has been engraved; it is accompanied by a description, with historic references, which might have been more complete if, at the time of writing, I had been possessed of the documents to which I shall soon allude. The whole is finished, but the circulation, with that of other parts of the Astronomical Volume, is delayed for a reason to be mentioned hereafter.

No steps, so far as I am aware, have been taken in the present year, for urging the proposal of a railway through Greenwich Park.

II. Moveable Property.—With the exception of auxiliaries to instruments, which will be treated under a special head, no changes of the least importance have been made in the property serving for the active work of the observatory. Its ornamental property has received a most valuable addition, in a bust of the highest merit, by Foley, of the Rev. R. Sheepshanks, many years a member of the Board of Visitors; presented by Miss Sheepshanks.

The Visitors are aware that, under the provisions of the Standard Act, an official copy of each of the two fundamental standards (that of length, and that of weight) is preserved in the Royal Observatory. In the late spring, some alarm was occasioned by the discovery that the Parliamentary Standard of the Pound Weight had become coated with an extraneous substance produced by the decomposition of the lining of the case in which it was preserved. The appearance was so grave that the Lords Commissioners of the Treasury decided immediately to follow the course prescribed by the Standard Act for cases of destruction or injury of the Parliamentary (National) Standard, namely, to compare it with the three parliamentary copies of which that at the Observatory is one. The comparison was made by Professor Miller of Cambridge. It is satisfactory to know that the National Standard was found to be entirely uninjured. It is also interesting to know that the Observatory copy contributed its share to the evidence on this point. The occurrence seems to prove the propriety of the arrangement legalised by the Standard Act, for restoration of the standard in case of loss or injury, namely that of comparison with certain official copies. It would have been a most laborious business to test the standard by reference to the weight of water, as was provided in the last preceding Standard Act.

III. Manuscripts.—The ancient manuscripts are preserved with the usual care; and the current and accumulating manuscripts are, in the first place, arranged and stitched together on a peculiar plan, which, after many years' experience, we have found to be very simple and satisfactory; and, in the next place, are bound as soon as the number of papers collected under each head requires it. The operations connected with this are generally entrusted to Mr. Carpenter. The manuscripts are properly catalogued.

On the day of writing this report, a packet of Bradley's MS.S., relating principally to adjustments of the Greenwich instruments, has been transferred by the Rev. H. O. Coxe, Librarian of the Bodleian Library, Oxford, to the Royal Observatory.

I adhere peremptorily to the rule of not permitting any original manuscript to be taken out of the Observatory except by my own hands, and to be kept under my own eye.

Lately, however, I have found the advantage of preserving duplicates which may be for a time lent from the Observatory. Several years ago (as was then notified to the Visitors), I was permitted, by the courtesy of the Vice-Chancellor of the University of Oxford, to make accurate transcripts of Bradley's original Greenwich Observations, then preserved in the Bodleian Library. More lately (as the Visitors have been informed), the originals themselves have been transferred by the Senate in Convocation to the Royal Observatory. The copy is therefore free for use; and at the present time the copy of the observations from 1748 to 1749 (hitherto not printed) is in the hands of Mr. Hugh Breen for the reduction of the observations (hitherto not reduced), and the copy of the observations from 1750 to 1762 is to be lent to Mr. Winnecke, for more complete reduction of the observations than was made by Bessel.

In my reports for some years past, I have alluded to the supposed loss of the Minutes of the Board of Visitors from 1784 to 1830. I now believe that there never was such a collection in a separate form. The Board of Visitors was, in fact, a Committee of the Council of the Royal Society, and its Minutes are, I believe, contained in the Minutes of the Council. The volume which I possess, extending from the institution of the Board to 1784, consists of leaves inserted in a guard-book. Having learned that detailed minutes connected with the Royal Observatory exist in the Minutes of the Council of the Royal Society, I solicited of the President and Council permission to have those minutes copied; and the passages bearing upon the Royal Observatory were selected and marked by the Assistant Secretary of the Society. My best thanks are due to the President and Council of the Royal Society, for the liberality and promptitude with which they acceded to my request. I am very glad to possess in the Royal Observatory a series of documents which illustrate so much (and in the latter part nearly the whole) of its official history.

IV. Library.—Some purchases are made by me, confined to the subjects which are followed in the active business of the Observatory; but the principle increase of books is derived from presents.

* Read at the Annual Visitation of the Royal Observatory, June 4, 1864.

Preparations are made for the new catalogue, but it is not yet begun. It is intended to adopt the method of moveable slips, now employed in the principal large libraries.

V. Astronomical Instruments.—The transit-circle is in perfect condition. The index-pieces, to which in my last report I alluded to as being suspiciously near to the micrometer-heads, have been filed, and the micrometers have been put in good order.

A trifling want of steadiness has been discovered in the object-glass of the north collimator, which may have produced some of the discordances that were attributed to instability of the ground. The fault has been corrected, but I am not yet able to say whether the discordances are removed.

A series of observations lately taken for determination of the astronomical flexure of the telescope has given a result of insensible amount of flexure. This differs from the results obtained in former years. The process is to be repeated; meantime, I may remark that, if the late deduction should be confirmed, I should attribute the difference to a difference in the firmness of fixation of the eye-end tube, which has once been taken off and replaced.

On November 16th of last year the instrument narrowly escaped serious injury from an accident. Shortly after the operation of raising the transit-circle (for comparison of the collimators and cleaning the pivots), but when no person was near, the plate-chain which carries the large western counter-poise broke. The counterpoise fell upon the pier, destroying the massive gun-metal wheels of the lifting machinery, but was prevented from falling further by the iron stay of the gas-burner flue. Had it forced this it would probably have destroyed the microscopes, and might have injured the building by its ultimate shock on the ground. On examination it was found that many of the individual plates of the plate-chain were broken through. I lost no time in requesting the assistance of Messrs. Ransomes to re-suspend the counterpoises from strong simple iron chains, and to prepare large pulley-wheels with grooves adapted to guide the links of the chains in their proper position. Subsequently iron box-sides have been mounted, for so inclosing each counterpoise that, if it should fall, it will not fall from the top of the pier.

The transit-clock (lately cleaned) is in good order. To enable us to use another clock by the chronographic method when the transit clock is temporarily dismounted, I have had seconds-contact-springs inserted in the North Dome Arnold. The chronograph is in general good order, but I contemplate altering the form of its water-resistance mechanism, to give it the same arrangement as that of the large equatoreal clockwork. The reflex zenith-tube is in good order.

The altazimuth is in good order. The pinion-axis of the moderately-slow motion in azimuth lately broke, at a point where a screw-hole had been drilled through it. It has been repaired in a safer form. Much of the brass of the azimuthal microscopes had become rotten, and has been replaced. A similar operation is to be performed shortly on the vertical-circle microscope.

The apparatus of all kinds for galvanic signals is in good order. The motor clock has been lately cleaned, with much attention to the maintaining mechanism, and to the galvanic-contact surfaces; ebonite has been substituted for ivory in some of the insulating parts, and in order to diminish the mechanical interference with the motion of the pendulum, two pairs of pendulum-contact springs have been removed, their circuits being completed by a multiple relay, which is worked by the springs that are left.

The Shuckburgh equatoreal is imperfect as regards its hour-circle microscopes, but in other respects is in good order. The Sheepshanks' equatoreal (lately separated and cleaned by Mr. Carpenter) is in perfect efficiency.

The south-east equatoreal has had no change since the last meeting of the Board; it is in a perfect working state. An eye-piece with reflection from the surface of glass, for viewing the sun, has been provided for it: a construction which is very useful, where the whole aperture of the object-glass is desired for good definition, and where the accompanying heat is great. The water-clock movement is most accurate; I propose to give it the last degree of exactness by the following arrangement. The arc of vibration of the conical pendulum will sometimes vary a little from variations in the height of the surface of the resisting water. To make the vibrations isochronous, the part which we have usually called the "spade-apparatus" requires to be loaded at the top so as to overtip a little. Some years ago I had computed the quantity necessary for perfect isochronism, and I propose soon to introduce the principle practically.

I have not had sufficient leisure to prepare for publication plans of the south-east equatoreal.

The prismatic spectrum apparatus has been altered in the manner described in the last report. Achromatic object-glasses are placed on both sides of the prism, so that each pencil of light through the prism consists of parallel rays; and breadth is given to the spectrum by a cylindrical lens. The spectral lines are seen straighter than before, and generally it is believed that their definition is improved.

Of the ancient instruments, the limbs of the iron quadrant and of the brass quadrant have been cleaned, and covered with a rather hard varnish, under the superintendence of Mr. Simms. The other old instruments have been cleaned under Mr. Simms' eye, and the results of the examination have been interesting. One old instrument has, since the year 1835 at least, borne the repute of being one of Flamsteed's. On carefully examining it we find that it is a perfect small equatoreal of the German form, with a steel polar axis, conical hole in the lower end for bearing on a conical pin, and brass ring near the upper end for bearing in a Y; above which are its telescope and declination circle on one side. The oldest equatorial with which I am acquainted is Flamsteed's equatorial sextant, of which we have an accurate drawing in a very rare engraving; its mounting was of the German form. From the style of workmanship, as well as the general form, and from the circumstance that all Flamsteed's instruments are reported to have been taken away from the Observatory, I am inclined to believe that this old equatoreal is of Halley's time. Besides the coarse graduation on a small circle, by which the position of its declination frame was registered, it has a better graduation by which the position of the telescope on the declination frame was registered, and by which small differences of declination could be measured. Halley's unsymmetrical transit is in fair order; we remark on it a delicate screw motion, which might alter the error of collimation before certain parts were firmly fixed together. Bradley's transit appears to us to have been well put together, and not to have been liable to the flexure which Mr. Pond attributed to it, and which I conceive to have arisen from an error of collimation, not then perfectly understood by Mr. Pond. There seems to have been in it a ghost-apparatus for determination of level-error. It was never strengthened by braces.

VI. Astronomical Observations.—By long tradition, which I trust will always be maintained in this Observatory, the first place in importance is ascribed to regular observation of the principal fixed stars, rather than of the small ones; to observations of the sun, including the annual determination of equinox and obliquity, as well as of the sun's place in its apparent orbit; to observations of ~~the known bodies of~~ the solar system; and to observations of the moon. Meridional observations only are employed for all determinations, except those of the moon's place; but for the moon (whose tables, containing many rapidly-changing inequalities, can scarcely be sufficiently compared with her observed places in the heavens, as liable to the interruptions, both systematic and irregular, to which meridional observations are exposed), extra meridional observations with the altazimuth are also used. It was mainly for observations of the moon that the Observatory was founded; at no other observatory has the moon been followed in the same way, through more than a century, at every hour of the night-transit; and at the present time, when the claims of different observations conflict, the preference is always given to the moon.

The stars observed on the meridian are principally of the following classes (the same as in 1863):—189 stars for clock-error; all stars not smaller than the fifth magnitude; circumpolar stars; stars in the Nautical Almanac lists conculminating with the moon or occulted by the moon; stars assisting in inquiries relating to proper motion or refraction, or serving as standards of reference for the motion of Sirius; a few supplemental to the Seven-Year Catalogue. Among these observations ought also to be included the zenith-distances of γ Draconis, determined with the reflex-zenith-tube at nearly every practicable opportunity. A list of the whole of Bradley's stars is in preparation for re-observation.

The sun, Mercury, and Venus are observed on the meridian on every week-day, when visible. The large superior planets are observed on week-days when they pass before 14h, or when they pass near the morning moon. The moon is observed on every day when she is visible on the meridian, without any exception.

For observations of the small planets a convention has been made with M. Le Verrier, founded on the following considerations:—No relief would be gained by dividing the observations of special planets among special observatories. The seasons at which it is particularly desired that this Observatory should be spared the labour of observing the small planets are the times when the observers are oppressed with the duty of observing the morning moon. These remarks sufficiently explain the motive for proposing to M. Le Verrier the following system, to which he has acceded with the utmost liberality. From new moon to full moon all the small planets visible to 13h are observed at the Royal Observatory of Greenwich. From full moon to new moon all are observed at the Imperial Observatory of Paris. All ephemerides, results of observations, &c., are communicated freely from each superintendent of observatory to the other. The relief gained in this way is very considerable, principally because I am not compelled to provide observers both for the early morning and for the late night, partly also because the hours of night observation of these bodies are made to cease at 13h. The corresponding diminution of computation, though not so great, is very sensible.

The number of meridional observations with the transit-circle from May 17, 1863, to May 20, 1864, is as follows:—

Transits (the two limbs being considered as two objects) ...	3,729
Pairs of observations of the collimators by the transit-circle.	304
Reflexion-observations of the transit-wires	295
Observations of collimator by collimator	61
Circle-observations of all kinds	3,999
Reflexion-observations of the zenith-distance-wire	309
Reflexion-observations of stars	260

(The two last classes of observations are included in that which precedes them.)

The observations of γ Draconis with the reflex-zenith-tube are:—

Pairs of observations (the instrument being reversed between)	64
Single observations	11

In taking the observations with the altazimuth the reading of the barometer has been corrected for the small error which was found to exist in it, and the thermometer has been read more frequently, and at smaller

interval from the observations. The numbers of observations with the altazimuth, in their various classes, are:—

Azimuths of moon and stars	672
Azimuths of the collimator	356
Zenith-distances of the moon	364
Zenith-distances of the collimator	356

The following is the number of complete altazimuth-observations of the moon when near conjunction with the sun. The time of the moon's meridian transit on the days of altazimuth-observation, will sufficiently define the distance of the moon from the sun:—

Between 21h. and 22h.	3
Between 22h. and 23h.	1
Between 23h. and 24h.	0
Between 0h. and 1h.	0
Between 1h. and 2h.	2
Between 2h. and 3h.	4

The whole number of days on which complete determinations of the moon's place have been obtained with both instruments is:—

With the altazimuth, 190, or 15·2 per lunation.
With the transit-circle, 111, or 8·9 per lunation.

The earthquake of October 5, 1863, 15h. 53m. was seen with the altazimuth by Mr. Ellis, who happened to be observing the collimator. The mark appeared to descend, to rise rather more, and to descend a little to its original position.

With the south-east equatoreal no observations of numerical character have been made. The solar reflecting eye-piece has occasionally been used for examination of the inequalities of light on the sun's surface, and the spectrum apparatus has been employed for view of spectra of some stars. A drawing of the nebula of orion (still in pencil) has been made with much care by Mr. Carpenter. No observations have been made with the double-image or wire micrometer.

The number of observed occultations of stars by the moon is 12, of which 7 were disappearances and 5 were reappearances. The number of phenomena of Jupiter's satellites observed is 11.

VII. Reduction of Astronomical Observations.—The following progress has been made in the various steps by which the right ascensions of objects observed with the transit-circle are inferred from the observations: Transits are corrected for instrumental errors, and reduced to the state of clock-time transits over the true meridian, as far as May 15; clock errors and clock rates are computed to May 14; apparent right ascensions of the object's centre are found to May 14; stars' corrections are computed as far as May 15 (except those not previously observed, whose constants are not yet prepared), and are actually applied to the apparent right ascensions as far as December 31, 1863; corrections for imperfect illumination of limbs to December 31, 1863; mean solar times are prepared to December 31, 1863. For inferring geocentric north polar distances from observations: True zenith distances corrected for instrumental flexure, zenith point, and refraction, are formed to May 12; stars' corrections (limited as above) are computed to February 16, and are applied as far as December 31, 1863; lunar parallaxes are computed and applied to April 12, other parallaxes are computed and applied to March 12; corrections for imperfect illumination of limbs are applied to December 31, 1863.

The different results of each star's mean right ascension, and for each star's north polar distance, are collected in what is usually called the "Ledger" form for the year 1863. The star catalogue for 1863 is completed; the number of stars is 765. The investigation for R — D is made for 1863, and gives a value nearly according (at the zenith distances at which the observations are most frequent) with that of the last years. The investigation for correction of colatitude for 1862 gives the smallest colatitude that we have yet obtained, namely, 38°.31′.21″·58. That for 1863, lately finished, gives 38°. 31′. 21″·79.

Right ascensions and north polar distances of sun, moon, and planets, deduced from observations, are compared with those computed from tables, to the end of 1863. The conversion of errors of R.A. and N.P.D. (taking the mean of groups) into errors of longitude and E.N.P.D., and other deductions from them, are completed for 1862, but are only commenced for 1863.

The observations with the reflex-zenith-tube are reduced to December 31, 1863.

The altazimuth observations are reduced, in different parts of the chain of calculation, to the following states:—Observed azimuths are corrected for instrumental errors and zero of azimuth, to April 25; observed zenith distances are corrected for zenith point and refraction, to April 25; tabular azimuths and zenith distances, to the same date; errors of moon's tabular R.A. and N.P.D., and errors of moon's tabular longitude and ecliptic N.P.D., to April 1.

The reduction of the equatoreal observations of 1862, to which allusion was made in the last report, and which was then unfinished, is now complete.

The occultations of stars by the moon are reduced to the end of 1862; no important step is yet made for those of 1863.

It appears from the transit-reductions that the personal equations of the observers have changed very little. Three observers, not often employed on transits, have changed, with reference to Mr. Dunkin, by + 0s·12, — 0s·09, and + 0s·08; but four assistants more frequently employed have changed by only 0s·00, — 0s·01, + 0s·01, and — 0s·01.

The azimuthal error of the transit-circle continues to make its annual oscillation; the error being always very small in the month of September. The azimuthal zero of the altazimuth is still liable to irregular changes.

I am not yet able to exhibit such a comparison of moon's N.P.D. derived from altazimuth observations, with moon's N.P.D. obtained by the use of the transit-circle, as will authorise me to say whether the small discordance which appeared to exist in former years is removed by the alteration of the altazimuth dome, and the improved practice of observation of its barometer and thermometer.

The seven-year catalogue of 2021 stars from observations in the years 1854-1860, which was mentioned in the last report as nearly finished, has been completed.

I request the attention of the Visitors to a white globe, on which we have laid down all the stars observed from 1836 to 1860.

VIII. Printing and Distribution of Astronomical Observations.—The astronomical printing for 1862 is somewhat increased by the addition of the appendixes containing the redetermination of the longitude of Valencia and the seven-year catalogue. And the magnetical and meteorological printing, for reasons which will shortly be mentioned, is unusually large. I have therefore thought it desirable, for 1862, to separate the printing into two parts. The astronomical volume for 1862 has been printed some time since, but to prevent the confusion which might arise from distributing this, the first part, alone, I have thought it expedient to wait for the completion of the second, or magnetical and meteorological part. Separate copies of the seven-year catalogue have been received, but I have not had leisure to attend to their distribution.

Nearly the whole of the manuscript of the principal sections of the observational part for 1863 (transits and zenith distances with transit-circle, azimuths and zenith distances with altazimuth, and comparison of altazimuth determinations with tables), is in the printer's hands. The following is the number of sheets already printed:—Transits, 4; circle observations, 2; azimuths with altazimuth, 1; zenith distances with altazimuth, 1; comparisons of observed and tabular places for altazimuth, 1.

In the section containing the results of observations of the small planets I propose to incorporate with our own the results of the observations made at the Paris Observatory, under the convention which I have described. This combination is approved by M. Le Verrier.

The whole impression of the volumes for 1861 and 1862 is 350 copies. The volume for 1861 has been distributed, and that for 1862 is to be distributed, to the same extent as that for 1860.

(To be continued.)

SILVER'S INDIA-RUBBER WORKS AND TELEGRAPH CABLE COMPANY (LIMITED).

An extraordinary general meeting of the shareholders of the above company was held on Thursday last, at the London Tavern, Bishopsgate-street, for the purpose of confirming the resolutions passed at an extraordinary general meeting of the shareholders on the 30th June last, and which were as follows:—

1st. The increase of the capital of the company by the issue of new shares; such aggregate increase to be of such amount, not exceeding £500,000, and to be divided into shares of £50 each, or of such respective amount, and to be allotted in such manner as the company in meeting shall direct, or, if no direction be given, as the directors shall think expedient.

2nd. The change of the name of the company from "Silver's India-rubber Works and Telegraph Cable Company (Limited)," to "The India-rubber and Gutta-percha and Telegraph Works Company (Limited)," according to the power given by the 13th section of "The Companies' Act, 1862."

3rd. The substitution of the following regulation in lieu of the regulation now contained in Article 44 of the Articles of Association of the company:— "All capital and all other moneys of the company not immediately applicable for any payment to be made by the company may be deposited or invested by the directors in or upon such personal or other securities or investments, other than stock or shares of the company, as the directors from time to time think proper."

Dr. Beattie having been voted to the chair, the secretary proceeded to read the notice calling the meeting. The minutes of the former meeting were then read and confirmed, after which the chairman remarked that that extraordinary meeting had been simply called to confirm the resolutions which had been agreed to at the last meeting, and which had just been read to them. He would therefore move that the resolutions agreed to at the previous meeting be now confirmed, which, having been put to the meeting, was carried unanimously.

The CHAIRMAN said that it might be satisfactory to them to be informed that the managing directors had just returned from the works in France and Belgium, and had given favourable accounts of the state of affairs there to the Board, who had been sitting that morning. Some little alterations and organisation will be required there, and there was a prospect of a very satisfactory businesss being carried on abroad as well as in England.

Thanks to the chairman and directors for the way in which they were conducting the affairs of the company having been moved by Mr. Reep, and carried unanimously, the chairman briefly acknowledged the compliment, and the proceedings terminated.

COMMUNICATION BETWEEN PASSENGERS AND RAILWAY GUARDS.

WE quote the following letters which have appeared in the daily papers upon the above important subject, with the hope of awakening the attention of telegraph engineers and electricians thereto, believing that it is to electricity that we must look forward for the most efficient means of effecting the object in view :—

Sir,—The time has now arrived when the subject of a proper means of communication, in time of danger, between railway passengers and the guards and drivers of railway trains, is likely to be forced on the consideration of railway companies; and as various plans are likely at the present time to meet with mature consideration, I beg leave, through the columns of your influential paper, to launch a suggestion which appears to possess the merit of being simple, practicable, and effective. The means are these :—I propose that there shall be affixed permanently, above the roof of each carriage, a small flag, furled, and a lamp, unlighted. By day the flag may be unfurled by mechanical means, at the will of a passenger. By night the lamps may be illuminated by similar means. Thus a particular carriage may be at once indicated to the guard of the train, whose duty it shall become to attend to these signals. To provide against wanton or unnecessary use of these signals the railway companies should have power to inflict penalty by fine or imprisonment.—I am, sir, yours, &c.,

Putney, July 12. A. J. P.

Sir,—At a time when the necessity of a mode of communication between the passengers of a railway train and the guard, or engine-driver, will be most earnestly canvassed, I trust you will be kind enough to publish, in your very valuable journal, the following simple plan for ensuring such a desirable communication. I would suggest that a tin tube be placed along the top inside of each carriage, and to each end of the tube projecting out of the carriage be fixed tubes of india-rubber, with junction screws, for the purpose of forming a connecting link from carriage to carriage throughout the train from the guard to the engine-driver. Suspended from the tube in each compartment of all the carriages would be an india-rubber tube, with a mouthpiece, to answer the purpose of a blowpipe. Now, if a whistle be fixed at each end of the tube thus formed, viz., one in the guard's box, and another close to the engine-driver, I think that a vigorous puff from any compartment would start the whistles, and thus give the desired alarm. It would not take long to connect the tubes before starting, not longer than trimming and lighting the lamps; but what is a little trouble to the feeling of security that would be felt by the passengers ?—I am, sir, yours, &c.,

July 12. J. B.

Sir,—To prevent the repetition of tragedies in railway carriages, it seems to me that a few simple expedients would be all that would be necessary. 1st. Carry out your suggestion of a communication between the compartments of each carriage, so that passengers in one might see what is going on in the next. 2nd. Add to every guard's van a glass projection of about eight inches on each side, so that the guard could command a view of the doors of all the carriages, and that, by waving a pocket-handkerchief, his attention would be attracted at once. This for the day. Then, by suspending the lamp of each carriage by a rod or pulley, and allowing the passengers the expedient of raising it in case of necessity, the guard—who can always see along the top of the carriages—would notice it, and it would be an easy danger-signal at night.—I am, sir, yours, &c., A. V.

July 12.

Sir,—As I am perfectly aware that any means of safety to the travelling community would receive the greatest attention through your valuable publication, I venture to suggest a plan at once cheap and effective, which can be applied to any existing carriages.

On the outside of each compartment let there be a brilliant red disc, which can be raised by a cord within the reach of any passenger; at night a lamp may be placed, the light of which would be intercepted by either of the discs when raised. The guard who sits at the end of the tender should be in a direct line with the disc, and by the aid of a strong handrail could walk by the foot board on the six foot side to the compartment so signalled.

I am, sir, yours respectfully,

Bath, July 12. PHILIP BRAHAM.

Sir,—Criminal deeds being not unfrequently perpetrated in railway carriages, perhaps you will allow space in your widely-read journal for the following hint to railway companies :—

Bells, or other means of communication with the guards, are obviously surrounded by many difficulties, and even if practicable cannot always be depended on.

Let, then, the companies at once set to work, and have a pane of glass placed in the division between each compartment of a carriage. If it should so happen that only three persons travel in one carriage, and two should be in one compartment of it, let the third be compelled, if they do not all ride together, to sit in the next compartment, so that there might be a means of seeing if anything wrong was going on, and thus affording means of identification, &c. Public safety will be a sufficient compensation for any curiosity that might be exhibited by any one.

The adoption of this plan, I am convinced, will give confidence to every [illegible]

Yours, &c., AN OCCASIONAL TRAVELLER.

July 12.

Sir,—I was but yesterday proposing to a railway official a somewhat similar plan for communication between passengers and guard to that advocated by your correspondent "A. J. P.," with the exception that I suggested the raising of a small metal disc on the top of the carriage instead of a flag, and that the lowering of this disc, after being once raised, should only be effected by means under the control of the guard on or in the carriage bearing the signal. One very important desideratum, however, in connection with any method of signalling, is to provide for the guard free and comparatively easy access to the carriage on which he may observe a signal raised. It appears to me that this could be most satisfactorily arranged by lengthening the wooden step boards at the sides of the carriages, so that when coupled up the two boards of adjacent carriages should meet on either side, care being taken to arrange for the "play" distance of the buffers; and further, that a running rod, to serve as a handrail, should be substituted for the existing single handles at the sides of the carriages; the step-board being also raised from its present almost useless position, about three feet below the floor of the carriage, to the level of the iron entrance-step. Now-a-days the van has usually a raised glass look-out, through which the guard can see over the whole train. Were the metal discs I suggest also made reflectors, a light thrown from the guard's van along the top of the train would show any of them raised by night quite as well as by day. Nothing but a simple arrangement for raising these discs, and one which could be easily used from either side of the inside of the carriage, is further required. Tubes and whistles will not do. Something which can be caught at and used in a moment by a weak or struggling person must form an integral part of any adopted plan.

July 13. I am, sir, yours, &c., R. W. H.

REVIEW.

LA TÉLÉGRAPHIE ELECTRIQUE : son Histoire Précise, Anecdotique, et Pittoresque, et ses Applications en France, en Angleterre, aux Etats-Unis, en Belgique, en Hollande, en Suisse, en Espagne, en Italie, en Turquie, en Russie, en Perse, dans l'Inde, en Cochin Chine, etc., etc. Suivi d'un Guide de l'Expéditeur de Dépêches. Par PHILIPPE DAURIAC.

A little volume of 116 pages, part of which is composed of tables showing the rates of charge for messages sent over the wires of different countries, has been recently published in Paris under the above ambitious title. A little more than two pages comprises all the information that the author can discover of sufficient interest in English telegraphy. America is dealt with in about the same space, and a few lines suffice for the other countries enumerated in the title, with the exception of the telegraphs in the French settlement in Cochin China, consisting of about 300 miles of line, and 12 stations at Saigon, Bien-Hoa, Cholen, Baria, Mytho, Thuan-keou, Tran-Bang, Long-Than, Thu-Yen-Moi, Tay-Ninh, Goden and Tan-an, to which is devoted about the same space as that apportioned to all the English and American telegraphs. In alluding to various projects for crossing the Atlantic by a submarine cable, M. Dauriac first takes in hand the direct route between Valentia and Newfoundland, for the success of which, however, he does not offer up any prayers, as he considers that it will give England the monopoly of telegraphic communication between the two continents, and that she will probably abuse such a privilege.

We cannot discover any description of novel telegraphic appliances, or proposals for new instruments or lines throughout the work, the extensive title of which will no doubt disappoint others as well as ourselves; but our readers will at least have the advantage of being forewarned as to the degree of enjoyment which they may anticipate from a perusal of M. Dauriac's pretentious treatise. It has been said that to write well one must write fast, and Goldsmith said that "everybody wrote better because he wrote faster than I"; but now-a-days the speed appears to have got up to a rate that requires checking. There is too much of this sort of book-making, and "La Télégraphie Electrique" is about the most glaring instance we have met with of a novice venturing to deal with a large and difficult subject, of which he has scarcely acquired even a glimmering of knowledge.

A FIRE ALARM TELEGRAPH.—A fire alarm police and water telegraph is about to be erected by Messrs. J. & F. Kennard, in Chicago, America, at a cost of 70,000 dollars. According to the specification a building for a central office is to be procured, and fitted up with all the necessary instruments, scattered all over the city, with 103 signal boxes. There will be 8 electro-magnetic bell-ringing machines, with 13 engine-house gongs with hammer and magnetic escapement to alarm the firemen the instant intelligence of a conflagration is flashed over the wires to the central office. In the police department of the telegraph there will be 6 indicating dial instruments with call bells, this will be one machine for each police station head-quarters and the central alarm office, so that information in regard to fires will be given from any police station. The superintendent will also be in a position to communicate at any instant with any or all of the station-houses. Each of the city reservoirs will be connected by telegraph with the waterworks, so that the condition of the water, whether high or low, can at all times be ascertained. A gong will also be placed in the waterworks and all alarms of fire will be given the same as at the engine-houses. This will allow a full head to be turned on the instant an alarm is given.

CORRESPONDENCE.

INDIA RUBBER COVERED CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—That something is still wanting to insure the permancy of caoutchouc covered cables doubtless all will admit, and the same may be said of every project, design, and enterprize under the sun. Here we all stand on common ground. The real point at issue is, what is that "something?" Doctors will disagree: It is this, that, or t' other, according to the stand point occupied, or the prejudice, or the interest, or the what-not of the eminent self-constituted jurists, but seldom the right thing. One of the "somethings" required to accomplish this desired object is to abjure the use of tar utterly on the serving of hemp that is put on the core. Don't say this is arrant dogmatism, and purely suppositious; it is founded on actual experience, and practical chemists will confirm the statement. Substitute tarred hemp with hemp simply steeped in water, and wrap it on wet, and you at once insure permanency of the core, because you bring nothing into contact therewith that can possibly do injury to the rubber—rather you add a preservative. How can we reasonably be surprised at the failure of India rubber covered wires when brought into immediate contact with such villainous stuff as tar! Do you know what enters into the composition of Stockholm tar? or, supposing you do, can you guarantee its entire freedom from extraneous matter? There is the point. Assuming it to be inocuous in its effect upon rubber when purely constituted, it would even then be dangerous to use, from the fact that its purity cannot be depended upon; the slightest mixture of any grease in it would destroy any cable, but grease or no grease, tar is destructive to India rubber.

At the time when the twenty miles of cable, referred to in your last week's number, was being tested at Mr. Henley's works, Mr. Hay, the Admiralty chemist, being present, remarked to Sir W. Brooke that no caoutchouc covered wires could be expected to last for any great length of time when covered with tarred yarn *in a moist state:* and further remarked, that had the yarn, after being steeped in tar, been dried before applied to the core, or had it been steeped in water only, it would have proved a preservative.*

It is notorious that in this instance the yarn was brought seething hot from the tar pot, and immediately applied, and this it was that led to the remark of the gentleman above referred to. Unquestionably this was twenty miles of good core spoiled by the rigorous martyrdom it underwent from this and other causes after it left the works of the manufacturers. This was partly foreseen by these gentlemen, and hence it was that they declined to be responsible for the core after it had passed the prescribed ordeal of Mr. Reid's pressure test, &c., and was thence handed over to other parties to do the sheathing; and here it may with propriety be stated that the makers of this core would not be responsible for the permanence of any cable that was not manufactured throughout under their own supervision and in conformity with the specification of their patent.

The object of this letter is to set ourselves right with the public. No one has any right to attribute the deterioration of an India-rubber cable to the unsuitableness of that material, unless it can be demonstrated that it is unsuitable after the cable has been manufactured entire by those who are thoroughly acquainted with the nature of the gum; it is equally disingenuous and unjustifiable to bring into disrepute the manufacture of any one who makes a core and who declines to be responsible for it when handed over to some one else to finish, when the parties who are chargeable with such an unworkmanlike procedure know that such responsibility is declined upon principle, and because the makers know that the subsequent handling it must undergo can do it no good but rather harm, and specially in this instance, seeing we have always entered our protest against the prevailing mode of manufacturing the outer part of submarine cables. We guarantee the permanency of the cables we manufacture entire, and fortunately we are in a position to produce the highest testimonials confirmatory of this; but we guarantee no cable *that passes into other hands to finish,* and if the twenty miles in question be in the condition described, the entire blame, liability, and responsibility is repudiated by the

MANUFACTURERS OF THE CORE.

[We insert the above communication with much pleasure, as the subject is one of the greatest importance with respect to the future of submarine telegraphy.—ED. T. J.]

* See also Professor Miller's Report Blue Book, page 340. In a conversation we had with Dr. Hoffman, on the 11th instant, that gentleman expressed himself strongly upon the matter, and condemned the application of Stockholm tar in the manufacture of cables, unless it could be prevented coming in contact with the insulation.

THE MALTA AND ALEXANDRIA CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Your correspondent, "One of the Public," has called attention to an item of £680 included in the estimates of the current year. The sum in question is the amount of the salary and travelling expenses of a superintendent appointed on behalf of the Lords of Her Majesty's Treasury. The appointment at the time it was made was the subject of much animadversion; the fortunate individual, a junior clerk in the Board of Trade, wholly unacquainted with the science of telegraphy, being selected. As far as I have been able to discover, the only recommendation was that of possessing the same patronymic as the President of the Board of Trade. Perhaps that it is owing to this fact that so much mysterious secrecy hangs over the operation of this line.

July 13, 1864. G. TWEEDALE.

COMMUNICATION BETWEEN PASSENGERS AND RAILWAY GUARDS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The frightful murder perpetrated on the North London Railway on Saturday evening, the 9th inst., has again revived the question as to the necessity of having a means of communication between passengers and the guards and drivers of railway trains. Several lamentable occurrences have happened, which might have been frustrated had there existed such means of communication. Numerous plans have been suggested and patented during the last twenty years, mostly by the application of electricity for the purpose, but every effort to induce railway directors and their officials to adopt any of the means suggested, have hitherto failed. Had there been a means of communication between the compartment in which the present murder was committed, even the knowledge of its existence might have had a deterring effect on the assassin; and in the instances of assault upon women which have taken place, the possibility of giving an instant alarm would prove a most effectual protection. A most efficient electrical apparatus could be fitted to each carriage at a very small expense. No difficulty whatever would be experienced in effecting the continuity of the electric wire by the addition to or detachment of any number of carriages from the train. I believe that in every other country in the world the means of communication between the passengers and the officers of the train exist except in England. I am, sir, your obedient servant,

July 14, 1864. J. LAWRENCE.

TELEGRAPHIC NEWS.

SPEZZIA AND CORSICA CABLE.—The submarine telegraph has been successfully laid between Spezzia and Corsica, and is now in excellent working order. The steamer Fanny Lambert has been engaged in this useful operation.

THE TELEGRAPH IN FRANCE.—An agreement has been entered into by the Governments of Italy and France, by which telegraphic messages may be sent to and from any portion of the two kingdoms at the rate of four francs for the simple message of twenty words.

LONDON DISTRICT TELEGRAPH COMPANY (LIMITED).—The above Company have issued a notice that the next half-yearly ordinary general meeting of the shareholders of the Company will be held at their offices, 90, Cannon-street, London, on Thursday, the 4th day of August next, at 2 o'clock, P.M. precisely; and the business to be transacted at such meeting will be the reception and consideration of the accounts, balance sheet, and report of the Directors, and other general business of the Company.

ANGLO-INDIAN TELEGRAPH.—Between Fao and Dewanigon, and over the incomplete portion of the intervening ground, mounted messengers will be despatched, twice a week at first, and daily as soon as relays of horses can be provided. Thus messages will pass between Europe and India in five days, until the opening of the Persian line completes the chain of telegraph. Colonel Stewart may fairly be congratulated on the success which has hitherto attended his exertions. We hear from Bussorah, up to the 2nd of May, news to the effect that the messengers will be despatched on the morning of each Tuesday and Saturday, and an extra messenger will constantly be in readiness to take on any message of unusual importance. Until regular districts are settled, these men must take a circuitous route, but the messages will be delivered in Bagdad in about five days. Arrangements have been made at Bagdad, and as soon as the Constantinople line is repaired, service messages and heads of general intelligence from Europe may be expected twice a week in Bombay. As soon as the country is quiet, relays of horses will be provided, and messages will then pass between Bussorah and Bagdad every day, occupying about two days in transit instead of five days.

NON-TARRED SUBMARINE CABLE.—Messrs. Wells & Hall have, within the past few days, delivered several miles of india-rubber covered wires for Government telegraphs, a few particulars of which we append, because the length of core evinces a proficiency of workmanship of a very satisfactory and reassuring character, and augurs well for the future of submarine telegraphy, if the same care is exercised and perfection attained in the manufacture of the outward part of the cable as is now attainable in what is technically termed the "core." The wire in question consists of a No. 18 (diam ·043) tinned copper, insulated to a total diam of ·25 inches; weight of copper per mile, 30lbs.; weight of insulator per mile, 60lbs. The resistance of the insulating medium for one mile, tested in water at a temperature of 60 degs. Fahrenheit is 4,750,000 Siemens' units; and the resistance of the conductor, 54 S. 26. It will be obvious from this that the insulation tests, both static and dynamic, are of a very high character in comparison with results obtained in other materials. No tar is to be applied to this core, on account of its well-known deteriorating effects when brought into contact with the rubber. The durability of this material is now satisfactorily established, if engineers will avoid the use of tar, and be more cautious that the protecting sheathing does not belie its character, by introducing an element or elements of destruction..—(*Communicated.*)

THE GREAT EASTERN.—Intelligence was received at Sheerness on Wednesday morning that the Great Eastern steamship had passed Dover at 4.50 a.m. on her passage from Liverpool, which place she left at noon on Saturday, the 9th instant, for Sheerness. It is intended to moor her at Sheerness for the purpose of taking on board the Atlantic telegraph cable, now in course of manufacture at the works of the Telegraph Construction and Maintenance Company (Limited) (late Glass, Elliot, & Co.), East Greenwich. Mr. R. A. Glass, managing director of the company, and Mr. Shuter, the secretary, arrived in Sheerness in the course of the day, to await the arrival of the Great Eastern, and to complete arrangements for her permanent mooring at Sheerness. The Great Eastern has been placed under the command of Captain Birch, an experienced commander of steam vessels, assisted by Mr. W. C. Moore, a Trinity pilot of considerable experience, who accompanies the vessel from Liverpool, Mr. Daniel Gooch, one of the directors of the Telegraph Construction and Maintenance Company, and also a director of the Great Ship Company, together with Messrs. Canning and Clifford, the engineers who are to be intrusted with the laying of the cable, are also on board, with a view of watching the working of the machinery. Three powerful steam-tugs awaited the arrival of the vessel at the Great Nore. At four o'clock in the afternoon of the same day the Great Eastern arrived at the Nore, and shortly afterwards bore up to Sheerness Harbour, where she was saluted by the Formidable flag-ship and other Government vessels lying off the dockyard, the compliment being promptly returned. The monster vessel appeared in excellent trim, working but a portion of her screw machinery, and she was towed into harbour by four steam vessels, two on either side. The pier, the whole frontage of the dockyard, and every available spot commanding a view of the noble vessel, was crowded by thousands of spectators, who greeted her by repeated cheers, and the excitement of the scene was enhanced by the arrival at the pier, at the same time, of the Orcad steam vessel, with the directors and shareholders of the Woolwich Steam Packet Company, returning from their annual trip to the Medway. The volunteer band on board this vessel and the whole of the passengers warmly joined in the manifestations of applause which prevailed. At six o'clock the big ship was moored in the harbour, where she will remain until she has shipped the whole of the Atlantic telegraph cable. Captain Superintendent C. Wise, A.D.C., of the Sheerness dockyard, placed at the disposal of the contractors the Locust steam-tug, Master Reuben Harvey, to assist in bringing the Great Eastern to her permanent moorings in the Medway of Sheerness, where ample space is afforded the vessel for swinging with every tide. The Admiralty has also placed at the disposal of the company the sailing ships Venus and Iris, for the purpose of conveying the cable from East Greenwich, where it will be manufactured. Both these vessels will be immediately fitted with large iron water-tight tanks, into which the cable will be coiled as completed. It will then be conveyed to Sheerness to be reshipped on board the Great Eastern, which will also be fitted with watertight tanks to receive it, ready for submersion. The fitting of the tanks on board these vessels and the shipment of the cable on board the Great Eastern will not be completed till about June, 1865, when it is intended to commence the operation of laying the Atlantic telegraph cable.

THE ANGLO-AUSTRALIAN AND CHINA TELEGRAPH COMPANY (LIMITED).—The prospectus of this company is in private circulation, and will be shortly published. In the first instance it is intended to issue capital for the first section from India (Rangoon) to Singapore, a distance of 1,200 nautical, or 1,400 statute miles. This will require a capital of £450,000, in 22,500 shares of £20 each. The board is composed of fifteen highly respectable names, and comprises representatives of the Peninsular and Oriental Steam Company, and other weighty interests. The trade to be accommodated by this section represents about £75,000,000 per annum, and stress is justly laid upon the importance of the proposed submarine telegraph to the shipping interest, the more especially as the stations will be near the coasts and Straits of Sunda and Malacca, along which lies the great highway for vessels to the East. Considering the special interest attaching to this undertaking, both in a political and commercial sense, it may be useful if we reproduce the following description of its objects as furnished to us by the promoters. We will merely add that the section in question can be completed in eighteen months. The Anglo-Australian and China Telegraph Company, which has been constituted to carry out a complete system of telegraphs between India, Singapore, China, Java, and Australia, is about to carry out the India-Singapore telegraph as its first work. To effect this object the company will lay a telegraph cable between Rangoon and Singapore, with intermediate stations at King Island and Penang. The length of this line is one hundred miles less than that of the Malta and Alexandria submarine telegraph, which has now been at work for nearly three years, and the cable can be laid in a depth not exceeding fifty fathoms, thus securing the permanence of the work, and enabling any necessary repairs to be executed with speed and certainty. The official returns of the receipts on the Malta and Alexandria telegraph show that the earnings of that line have steadily and rapidly increased since its first opening in 1861. Thus the receipts in the last quarter in each year have uniformly proved nearly double those of the first quarter in the same year. In the last quarter of 1863 the Malta and Alexandria telegraph was earning at the rate of £86,240 per annum, which amounts to 20 per cent. gross upon the cost of the line (£436,000), and say 16 per cent. nett. There is every reason to believe that the India-Singapore line will be still more profitable. The India-Singapore telegraph will place the whole of India in direct telegraphic communication with the Straits of Malacca and with Singapore, and will reduce the time for communicating with Batavia, the Straits of Sunda, Hong Kong, and Shanghai, to about the time occupied by the mail steamers between Singapore and those several points. The enormous amount of shipping engaged in the trade of India and of Europe with Singapore, Java, and China all passes through the Straits of Malacca or of Sunda, and will extensively use the India-Singapore telegraph for communications with owners, consigners, and consignees of cargo, insurers, &c. A submarine line is eminently adapted to accommodate shipping in consequence of the proximity of the stations to the coast. There is also a very large coasting trade between India and Singapore carried on in native vessels, which will largely use the telegraph. The advantages of the proposed line by no means depend upon the completion or maintenance of telegraphic communication between Great Britain and India, the trade between India, Singapore, and China, and the local trade of the Straits will in any case be directly accommodated by the proposed telegraph.—*Malta Observer.*

MISCELLANEA.

WHAT NEXT?—Telegraph wires are now being erected to cross over the summit of Mount Washington, to connect all the public-houses in that region with each other and with Boston.—*New York Observer.*

THE METAL LITHIUM.—This metal is the lightest known solid. It floats in naphtha, and yet can be drawn into a fine wire. It is harder than potassium, but softer than lead. It does not inflame in water, like sodium, but does so when dropped into fuming nitric acid, the most active oxydizing agent known.

CALCULATION.—A flash of lightning on the earth would be visible on the moon in a second and a quarter; on the sun in eight minutes; on Jupiter (when furthest from us) in twenty-five minutes; on Uranus in two hours; on Neptune in four hours and a quarter; on the Vega, of the first magnitude, in 4,000 years; yet such stars are visible through the telescope!

UNIT OF FORCE OF CURRENT.—Every conductor of electricity, however good, opposes some resistance to its propagation, and many researches have been made to determine the laws of the transfer through conducting media. Galvanic electricity tends to diffuse itself through the whole capacity of a conductor, and consequently the resistance to conduction is in proportion inversely to the transverse section of a conductor.

INDURATION OF IRON.—The iron work of the new bridge at Blackfriars is to be indurated by a process patented by Messrs. Morewood & Co., and is alike important from the great cost which will be incurred, and the testing of a rather abstruse chemical formula for the preservation of iron from oxidation and decay. The process is as follows:—The iron is to be thoroughly cleaned, and heated to the requisite temperature in a furnace planned by the inventors. When this temperature is attained, it is to be plunged into a bath of prussiate of potash and chloride of potassium, in a molten state, so that when the iron is withdrawn it may easily part with the surplus of the aforesaid chemicals, which should run off like oil. The iron is then to be dipped into boiling water, containing a certain proportion of cyanide of potassium; from thence it is removed to a bath for a final washing, and set up on end to dry. All the processes are to be carried on under cover, and before exposure to the atmosphere the iron is to be coated with an asphaltum paint twice, at given intervals; and again it is to receive two coats after fixing. Of course, all the necessary planing, drilling, and fitting, is to be done preparatory to the indurating. The time the iron is to remain in the bath will vary from one to five minutes, according to the weight of the metal to be operated upon. The elaborate character of the process to which the contractor is rigidly bound, will account for the large sum to be expended in carrying out this part of the work; £4 per ton is allowed to the contractor for the induration and painting; Messrs. Morewood will receive from the contractors 5s. per ton as their royalty, which it is estimated will be £1,000. Thus £16,000 is to be spent in this effort to prevent oxidation, no greater proof of which, in its damaging results, can be offered than the case of the cleaning of the oxide (or rust) from the Menai Bridge, from which has lately been removed above forty tons of oxide of iron.

Telegraph Lines in Belgium.—On the 1st of January, 1864, the Government telegraph had been extended over a distance of 2,647 kilometres. In this line the number of conductors employed varies from 1 to 15; the total length of copper wire in use exceeding 6,238 kilometres.

Military Telegraph in the United States.—This important branch of the United States war department was considerably extended in the year 1863. The Government now maintain 5,326 miles of telegraph, of which 1,755 miles (aerial and submarine cable) were constructed last year. The number of war messages, mostly characterised by extreme urgency, transmitted by this line amounted to 1,200,000, or about 3,000 per day, each telegram containing from 10 to 1,000 words.—*Annales Télégraphiques.*

The Most Useful Metal.—"That iron should have been one of the last metals to come into general use," says Mr. Smiles, "is partly accounted for by the circumstance that, though it is one of the most generally diffused of minerals, it never presents itself in a natural state except in meteorites; and that to recognise its ores and then to separate the metal from its matrix demands the exercise of no small amount of observation and invention. The effectual reduction of the ore requires an intense heat maintained by artificial methods, such as furnaces and blowing apparatus. But it is principally in combination with other substances that iron is so valuable when compared with other metals. Thus, when combined with carbon in various proportions, substances are produced so different, but each so valuable, that they might almost be regarded in the light of distinct metals—such, for instance, as cast iron and cast and bar steel; the various qualities of iron enabling it to be used for purposes so opposite as a steel pen and a railroad, the needle of a mariner's compass and a six hundred-pounder gun, a surgeon's lancet and a steam-engine, the hair-spring of a watch and an iron ship, a pair of scissors and a steam-hammer, a lady's ear-rings and a tubular bridge."

The Cause of Diamagnetism.—Professor Maas, of Namur, in a communication made to the Royal Academy of Sciences of Belgium, expresses his opinion that water is the determining cause of the diamagnetism of certain organised substances. He states that Faraday, in his work on magnetism, has ranged elderpith and ivory among diamagnetic bodies. After having observed the diamagnetism of a small prism of elder, he was surprised to find it changed to para-magnetism a short time afterwards. In order to ascertain the cause, he cut from a long cylinder of oldish elder-pith two prisms, using a knife electrotyped with copper. One of these prisms was left exposed to the air, the other was enclosed in a flask containing some drops of distilled water. The first was found to be powerfully axial-magnetic, the other as powerfully equatorial. M. Maas hence concludes that the water made the latter diamagnetic. Several slices of ivory cut in different directions from an old piece equally surprised him, since none placed itself across the axis of the magnet; one placed itself axially; another made a very open angle with the same axis. A third example was a small cylinder composed of starch, gum arabic, and water. Freshly prepared it placed itself transversely, but when spontaneously dried it became para-magnetic. "Hence," says M. Maas, "we may be permitted to suppose that many natural organic substances owe their diamagnetic property to the interposition of liquids, of which water forms the larger proportion." The apparatus employed in the experiment was a Faraday's electro-magnet, modified by Becquerel and constructed by Secretan.

Atmospheric Investigation.—Mr. Glaisher, in a recent communication to the morning papers, makes the following statement:—There was one peculiarity in this ascent, as I before stated, distinct from all others, and that was the frequent freedom from any revolution of the balloon; at times for ten or fifteen minutes certain objects kept in the same azimuth: this enabled me to take twenty different sets of vibrations of a horizontal magnet with as much accuracy as I can take them on the earth. The results of these experiments showed clearly that the magnet vibrated in a longer time than on the earth. This result is very valuable in our present state of magnetical knowledge. There were in the car, in addition to Mr. Coxwell and myself, Mr. Woodroffe, Royal Horse Guards, Mr. W. F. Ingelow, Mr. E. Atkinson, Mr. J. Atkinson, Mr. F. W. Ellis, and Mr. Collins. At the height of 1,600 feet the number of pulsations in one minute of the several gentlemen were as follows:—Mr. Woodrooffe, 120; Mr. Ingelow, 108; Mr. E. Atkinson, 78; Mr. Coxwell, 84; Mr. Collins, 108; and myself, 104. The number of respirations in one minute were:—Mr. Woodroffe, 19; Mr. Ingelow, 18; Mr. E. Atkinson, 17; Mr. Collins, 11; Mr. Coxwell, 15; and myself, 18½. Mr. Collins repeated the experiment with the same result, and spoke very decidedly about his correctness. The ratio of respirations to pulsations were therefore as follows:—Mr. Woodroffe, 1 to 6; Mr. Ingelow, 1 to 6; Mr. E. Atkinson, 1 to 5; Mr. Collins, 1 to 10; Mr. Coxwell, 1 to 5½; and myself, 1 to 5½. At midnight, at Brookland, Mr. Coxwell's pulsations were in one minute 90, Mr. Collins's 94, and mine 88; our respirations were 18, 15, and 17½ respectively; therefore the ratio of respirations to pulsations were—Mr. Coxwell, 1 to 5; Mr. Collins, 1 to 6; and mine, 1 to 5. The ratio of my ordinary respirations to my ordinary pulsations is as 1 to 4½, so that the removal of even that small amount of atmospheric pressure, as experienced on this occasion, disturbed the system, but with undoubted advantage, as enjoying the pure air of the mountains without any fatigue, increasing the ordinary pulsation by 20 to 30 in one minute, increasing also the number of respirations, but not in the same degree. This disturbance lessened, but had not ceased 2½ hours after we were again on the ground. On the following morning my pulsations numbered 76 and respiration 17 in one minute, and had therefore assumed their normal action.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1720. R. A. Brooman, improvements in batteries and in electric printing telegraphs.—A communication.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1538. W. J. Pughsley, improvements in obtaining sulphuric acid from the refuse "pickle" used in tin plate works, and also from sulphate of iron or green copperas.

1545. J. Forbes, improvements in the means of, and apparatus for, manufacturing sulphate of ammonia and sulphuric acid.

1565. J. D. Adams, improvements in electrical communicators.—A communication.

PATENTS SEALED.

169. F. J. Ritchie, improvements in the application of magneto-electricity to the propelling and controlling of sympathetic clocks.

PATENTS ON WHICH THE STAMP DUTY OF ONE HUNDRED POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1873. F. C. Hills, improvements in the manufacture of sulphuric acid.—Dated 6th July, 1857.

1947. W. E. Newton, improvements in the manufacture or reduction of platinum.—A communication.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good .... 2/2 to 2/6 per lb.

India Rubber.

Para, first quality .... 1/9 to 1/10 „
second „ .... 1/6 to 1/7 „
third Negro-head .... 1/2 to — „
Java and Penang .... 1/4 to 1/5 „

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	102 to 105	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	1½ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	2½ to 3½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to par	—

TO CORRESPONDENTS.

Electric and International Dramatic Club.—A report of the benefit performance of the 14th instant will appear in our next.

W. J. M., Richmond.—The information you require will be found in the Parliamentary Return of Miscellaneous Statistics. In the *Telegraphic Journal* for 2nd January you will find a statement of the number of public messages sent by telegraph during the years 1859, 1860, and 1861; beyond this date no Government statistics of the telegraph have appeared to our knowledge.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before Seven O'Clock on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.		£.	s.	d.
Whole page	4	4	0	Quarter page	[illegible]	[illegible]	[illegible]
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THE TELEGRAPHIC JOURNAL.

VOL. II. No. 30.—JULY 23, 1864.

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FORCE AND FORM.

CONTRIBUTED BY B. M.

III.

No doubt it will be said, that the facts are against me: that attraction does take place in straight lines: that gravity is in straight lines: that Ampére's laws of the attraction and repulsion of parallel electric currents prove, that attraction and repulsion are in straight lines: as also his laws of angular currents. Well, I will not say, all the worse for the facts; because I have a profound reverence for a fact. At least I may be permitted to say, let us see whether this thing be so or not.

As to whether gravity does take place in straight lines, I would not like to attempt to say anything at all; because I know just nothing about it: and moreover I do not know anybody who knows anything about it; so we will let that stand till we have some facts to speculate upon. As to Ampére's laws—well, I do know somewhat about them, both at first and second-hand, and also of his theory of magnetism. What I would desire to be permitted to do, would be to study Ampére by the light of Ampére. Here are his laws:—When two parallel metallic wires are traversed simultaneously by an electrical current, the wires are either attracted towards or repelled from each other, according to the relative directions of the two currents. When they move in contrary directions, as shown by the arrows in Fig. 1, there is mutual repulsion, and when in the same direction as in Fig. 2, there is mutual attraction.

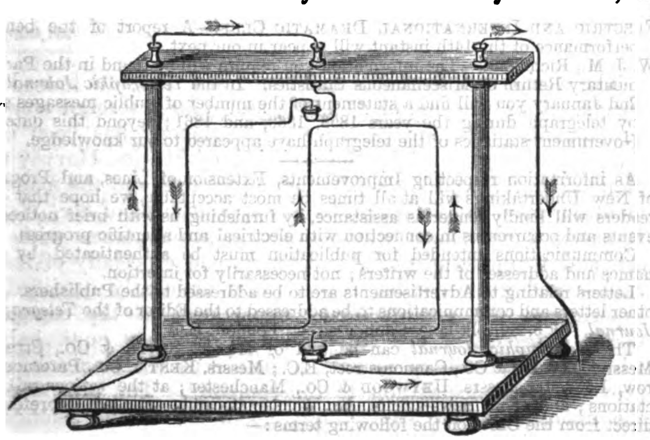

FIG. 1.

As to Ampére's mathematical laws, which govern the force of the attraction and repulsion, I have nothing to do here; for they are equally applicable whether the attraction and repulsion takes place in straight lines or spirals. Before we examine these laws of attraction and repulsion of electric currents let us first state, as clearly as we can, Ampére's electro-dynamic theory of magnetism.

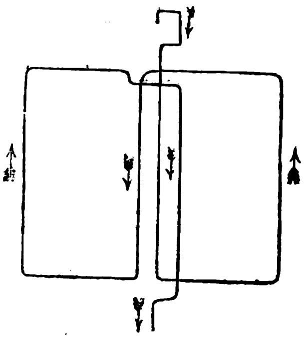

FIG. 2.

Having observed the mutual action of *solenoids* and permanent magnets, and also of electric currents generally, he was led to deny the existence of a magnetic fluid, and to consider all magnetic phenomena as the visible effects of electric currents perpetually circulating round the ultimate particles of which the magnet is formed, each magnetic atom being considered not only as a perfect magnet, but also as a perpetual electric circuit, somewhat similar to a solenoid, which is a spiral of wire with one end brought straight back through the centre. Every magnet is composed of these little magnets, their spheres of power coalescing to form one great magnetic sphere, the electric currents flowing round at right angles to the axis of attraction, or magnetic axis. Now, reducing this to its ultimate, we shall get one spiral current, or single curve of the solenoid, one side of which will act as a north pole, and the other side as a south pole, therefore in any two, the like sides will repel, and the unlike attract, which is actually found to be the fact in spiral currents. Now, what have we in Fig. 1, where the current in the fixed support moves in an opposite direction to what it does in the moveable rectangles? As all curved lines are made up of an infinite number of straight lines, there are segments of every imaginable curve in these straight lines, consequently they will act in precisely the same way as single spirals, and in these two, one is inverted, or turned round, so that we have the current flowing in the opposite direction, that is, like side is opposed to like side, which is equivalent in a magnet to north being opposed to north, or south to south; consequently repulsion must ensue.

In like manner, if the moveable rectangle in Fig. 2 be substituted for the rectangle in Fig. 1, the unlike sides of the current will be opposite; therefore, unlike magnetic polarities, will be induced; and consequent attraction must ensue, according to Ampére's own theory, for his theory affirms, that currents of electricity excite magnetic attraction at right angles to themselves. Certainly he denies altogether the existence of any magnetic fluid, and, as far as I can understand, he considers magnetism but a manifestation of electricity. Still, to develope magnetism a spiral current of electricity is necessary according to his theory of magnets. As we proceed we shall be able to show that magnetism and electricity are at least two distinct forces. What we wish to show here is, that according to Ampére's theory, if magnetism be induced at all, it is in spiral currents of force; therefore, in the cases shown the attraction and repulsion takes place in spirals, and not in straight lines.

Let us now see if his angular currents are governed by the same law.

Two rectilinear currents, which diverge from, or converge to a common point, mutually attract. If one converge, and the other diverge mutual repulsion ensues.

Let a b and c d be two currents crossing at the point e; there will be attraction between a e and c e, and between d e and b e, but there will be repulsion between a e and d e, as also between c e and b e.

Now, if the dotted lines, s n, represent the axes of magnetic

force which will be induced by the currents, *a b* and *c d*, it will be clear why the currents, *a e*, *c e*, and *b e*, *d e*, attract each other, and why *a e*, *d e*, and *c e*, *b e*, repel each other; for between the former two pairs the unlike poles are opposite, and in the latter two pairs the like poles are opposite.

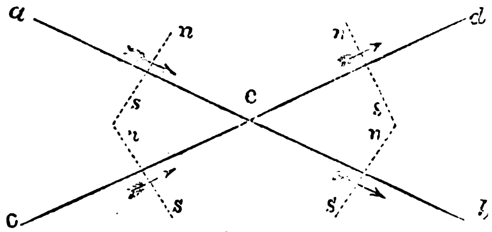

FIG. 3.

Moreover, it is clear from the following experiment (which experiment is well known to everybody), that simple currents do not attract or repel. Let the dotted lines represent a magnetic needle suspended over the current; it will place itself at right angles to the current, with its equator exactly over the current, if it be freely suspended, and if it be suspended with one of its poles just over the current, that pole will not be attracted by the current; but will pass over it, till the equator of the needle be brought in a line with the current, clearly showing, that the needle is not attracted by the current, but is simply striving to place itself parallel to the axis of magnetic force, which is induced by the current: in fact, conducting itself as if there was an invisible needle placed under it at right angles to the current.

So much, then, for Ampére's laws of the attraction and repulsion of parallel and angular currents of electricity. It appears from a little further generalization that they are simply cases of his one great law of magnetic induction, and that the currents themselves do not attract or repel each other at all, but it is the magnetism induced by them, and that force of necessity acts in spirals.

Mechanically speaking, what form of matter can be conceived, which will have a drawing or repelling power when force is exerted in it, in an onward, or backward direction, but a spiral? Is not the screw the universal application of this form? Nor can any other be supposed, as far as I can see. When speaking of mechanical motion, there is one curious fact that I will state, which is shown by the compound gyroscope, a fact well known to all those, who are practically acquainted with mechanical motions. If the inner ring of the gyroscope be put in motion, then the outer ring will commence to move in the opposite direction: but I have seen this more clearly exhibited in a lathe. In turning a piece of metal in a lathe, whose right hand centre was loose in the socket, the fixing screw having become slack, the centre began to turn round in an opposite direction to that in which the metal was being turned. What I would particularly take note of in this is, that motion induces motion in the same plane, but in an opposite direction. This, by the way, we shall have to refer to, when treating of induction: I do not mean of electricity only, but of force generally.

THE INDIA-RUBBER AND GUTTA-PERCHA AND TELEGRAPH WORKS COMPANY, LIMITED.

THIS project, lately brought into the money-market as "Silver's India-Rubber Works and Telegraph Company, Limited," with a capital of £500,000, is now in a very fair condition. The purpose of the Company was to purchase the extensive india-rubber and telegraph business of the Messrs. Silver, carried on in Bishopsgate-street, London, and at Silvertown, Essex. So soon as the required capital had been subscribed, however, it transpired that another company (supported by gentlemen of capital and influence) was in course of formation, having for its object the introduction of improvements in the manufacture of india-rubber and gutta-percha goods. This, it was thought, might possibly lead to unnecessary competition. It was accordingly adjudged wise to endeavour to effect an union of interests; and, as favourable opportunity offered for amalgamating several continental establishments engaged in the gutta and rubber trades, negotiations were entered into which rendered it necessary to increase the capital to £1,000,000 sterling. The sanction of the shareholders to these proceedings of the directors has been obtained, and a very powerful organization, under able superintendence, has been developed for the employment of the new gum, balata, in the manufactures so successfully carried on for many years by Messrs. Silver. The above arrangements have not been effected without great exertion on the part of the managing directors, and it is due to the indefatigable labours of the Messrs. H. A. Silver and J. W. Willans, that so desirable a fusion of interests has been brought about.

Some idea of the promising character of this undertaking may be derived from the statement made by Dr. Beattie, at the late meeting of the shareholders:—"Within the last three months the business of the firm of Messrs. Silver & Co. has increased 20 per cent. over that of the corresponding period of last year; whilst in one department, since May, 1863, the returns have been trebled." It appears that of the original capital, only £250,000 worth of shares has been issued. Of the £500,000 additional capital proposed to be raised, in order to meet the probable extension of trade, it is determined to allot £250,000, of which the French and Belgian interests have the option of taking £100,000, and the new gutta-percha company, £150,000, of which they have pledged themselves to take £100,000, leaving £50,000 for disposal among their friends. Accordingly there is abundant opportunity for further investments, should the directors determine to raise the whole of the capital, as will be seen by the following figures:—

Issue of Original Capital	£250,000	
Concession to the French and Belgian interests	100,000	
Apportioned to the New Gutta-Percha Company	150,000	
		£500,000
Unappropriated		500,000
		£1,000,000

The works and freeholds in France and Belgium have been purchased for the sum of £65,000, and a large foreign trade is anticipated. The directorate of the company has been considerably strengthened by the addition of Messrs. Harvey and Henderson, the well-known Borneo merchants, and the management has been supplemented by the appointment of Mr. Walter Hancock, a gentlemen whose practical acquaintance with the arts and manufactures of this country, and especially of india-rubber and gutta-percha, renders him eminently qualified to superintend the manufacturing department of the company. Great expectations are entertained of the new gum, balata, which, in the hands of so able a chemist as Mr. Hancock, may prove a great acquisition to the company. The prospects of the undertaking are exceedingly good, and as the science of electricity, in its application to telegraphy, is becoming more precise, there is every probability of a large business being done in the manufacture of submarine cables. A comparative monopoly in this trade appeared imminent awhile ago, but we have reason to believe that the India-Rubber and Gutta-Percha and Telegraph Works Company will be able to effect important improvements in subaqueous telegraphy, and render the business less exclusive in character.

INSULATION.—The Gutta Percha Company represents that the Dover and Calais cable exhibits no deterioration after a submersion of thirteen years.

ON THE MEASUREMENT OF ELECTRICAL TENSION.

BY LATIMER CLARK, M.I.C.E., F.G.S.

I.

IN conducting some experiments for the British Government on the phenomena which present themselves in connection with the manufacture and working of submarine telegraph cables, it became necessary to employ certain new methods of measuring electrical tension, some of which are herein described. The term *tension* is here intended to signify electromotive force, or potential, or the difference of state which subsists between the two coatings of a charged Leyden jar, or the poles of a battery, and which causes a current to flow between them whenever a wire is connected from one to the other; many instruments have been invented for measuring the higher tensions, such as the electrometers of Milner, Coulomb, Snow Harris, &c., most of which depend on the attraction or repulsion of electrified bodies, but none has been described for directly measuring lower tensions, such as those of a voltaic battery or a single galvanic couple, although these tensions are so constantly used in practice.

The tension of a single cell of Daniell's battery forms a very convenient unit and one often referred to, and the instrument about to be described is designed for subdividing this unit of tension into any number of equal parts. It consists of a board of any convenient length, having a fine platinum wire stretched upon it and attached at each end to blocks of metal, which are provided with convenient screws for the attachment of wires; the space between the blocks is graduated into one hundred equal divisions. A constant difference of tension, equal to one unit is maintained between the two blocks, and for this purpose a single cell of Daniell's battery is connected by wires to the terminal blocks, so as to form a circuit through the platinum wire, and a galvanometer is interposed in the circuit to indicate when any current is passing. In addition to this circuit a second battery of two or more large cells is connected between the two terminals, with a rheostat included in their circuit to enable the operator to regulate the quantity of electricity furnished by the battery; these cells are connected in the opposite direction to the single cell, and when joined up they overpower it, sending a current through the platinum wire in an opposite direction to that of the single cell, and also a reverse current through the cell itself; by lengthening the wire of the rheostat the force of this current is now reduced until it no longer overpowers the single cell, but just balances it, the needle standing at zero, in which condition a slight alteration of the rheostat in one direction or the other, causes either the one or the other battery to preponderate, and enables the operator to maintain the single cell perfectly inactive, as indicated by the galvanometer; in this condition the difference of tension between the two ends of the platinum wire is exactly equal to one unit, and, by a well-known law, the tensions at different points along the wire vary directly as their distances from the extremities. The instrument is used in the following manner:—Let us suppose that it is desired to measure the electromotive force of a couple of metals having less energy than the Daniell's cell, as for example iron and zinc; these are arranged as a galvanic couple, the size being immaterial, and an extremely sensitive galvanometer is connected with them, the zinc side being connected to the same block as the zinc plate of the single cell, and the other end remaining free; if now the free end be placed in contact with the other block, the feeble tension of the zinc and iron couple will be overpowered by the Daniell's cell, but if connected to the platinum wire near the zinc block, the couple will become active, sending its own current through the platina wire, and in either case its galvanometer will be deflected to one side or the other; by now sliding the free end along the platina wire, an intermediate point is readily found at which the tensions are exactly balanced, the needle of the galvanometer resting at zero, and the degrees in hundredths of the unit are then read off upon the graduated scale. It is obvious that the difference of tension between the two blocks may be made greater or less than one cell, all the degrees on the scale becoming magnified or diminished in proportion; the accuracy of the instrument has been verified in this manner up to a tension of 200 cells Daniell.* In the same manner the value of each degree may be increased tenfold by employing fifteen or twenty cells for the larger battery and connecting the standard cell at the tenth division on the scale. The platina wire may advantageously be doubled to and fro on the board to increase its length; it of course has its temperature affected by the passage of the current, but the increase being uniform it does not affect the accuracy of the measurement.

Another kind of measurement much used in the investigations above referred to, consisted in charging a length of submarine telegraph cable inductively, by connecting it with the source of electricity, and estimating the degree of tension by observing the amount of electricity discharged, when the cable was placed in connection with the earth, the discharge being measured by the deflection of the suspended needle of a delicate galvanometer. It is found with most galvanometers that within very considerable limits the arc of deflection varies nearly in proportion to the quantity of electricity discharged from the cable, and consequently nearly in proportion to the tension with which it has been charged; the error of each instrument is readily ascertained and tabulated by charging successively, one, two, four, &c., similar lengths of cable, or by charging a given length of cable with varying numbers of cells, and observing the deflection when the charge is suddenly allowed to return through the galvanometer to the earth; if the instrument be wound with very fine wire, a single mile of cable will measure deflections; with a less sensitive instrument, or a lower tension a greater length of cable is requisite;† the needle should be long so as to vibrate slowly; as it is known to what point the needle will arrive, it is easy, by the use of a magnifying glass, to read with great accuracy, and the mean of many observations should be taken. The needle must be rendered motionless before each observation, which is readily effected by approaching the poles of a very feebly magnetised steel rod to the centre of the needle while oscillating, increasing its distance each oscillation.

As the discharges from a submarine cable are very constant and little affected by temperature or other causes, this form of measurement admits of considerable accuracy; like the former arrangement, it is well calculated for measuring the electromotive force of various combinations of metals, or of batteries up to several hundred cells. A length of cable connected with an elevated wire or flame would slowly acquire the same tension as the atmosphere at that spot, and enable much more feeble tensions to be measured than can be detected by the electroscope. A cable connected with a long insulated telegraph wire would assume internally the same tension as the earth at the spot where the wire was connected with the ground, and during aurora borealis would accurately show the difference of tension between the two stations.

Its most interesting application has, however, been to the determination of the tension at the different parts of a simple galvanic couple, and the result has been as unexpected as it is instructive. Ever since the discovery of the galvanic battery philosophers have held divided opinions as to its nature and mode of action, and many of the greatest names in science have at different times ranged themselves either on the side of the "contact theory" or the "chemical theory." The object the

* See Government Report on Submarine Cables, p. 295, or a pamphlet entitled, "Experimental Investigation of the Laws which affect the Propagation of the Electric Current in Submarine Cables," by the author. London, 1861: Eyre & Spottiswoode.

† See Report, or pamphlet, above-mentioned.

author sought to attain was to measure the tension at the zinc plate, at the copper plate, and at all points of the intervening solution; for, although it is well known that the tension of the one plate is above that of the other, it is not known whether the tension increases gradually in the liquid from one plate to the other, or whether half the increase takes place at the surface of each plate, or whether all the increase occurs abruptly at one plate or the other. The experiments made have, however, shown that all the change takes place at the surface of the zinc plates, and have proved, moreover, that the presence of a negative metal is not at all necessary to the formation of the galvanic current, and that its presence or absence has no influence on the result. The contact of a single oxidizable metal with water is all that is requisite for the formation of the current. The following experiments will illustrate this:—A length of fifty or a hundred miles of telegraph wire or submarine cable is immersed in water, and one end insulated; the other end is connected to a very sensitive galvanometer wound with fine wire. A piece of copper is laid on the moist earth, and connection is made with it by a wire of any kind of metal leading from the galvanometer; of course no effect is visible; the copper being removed, a piece of zinc is substituted, and connection made as before; at the first contact a discharge is seen to pass out of the cable through the zinc to the earth, more or less powerful, according to the length of cable employed. No effect is produced at the second or subsequent contacts, even if a fresh piece of zinc be employed; but if a piece of copper be again substituted, a charge is seen to enter through the copper into the cable, and its amount is found to be exactly equal to that which left it at the first contact with the zinc. If the cable be now connected with an ordinary galvanic pair of zinc and copper, the amount of charge entering or leaving the cable is found to be precisely the same as when the metals were used separately and singly. Again, if the cable, after being connected with platinum, be successively connected to copper, iron, and zinc, three separate weak discharges will be seen to leave it, or if it be connected at once to zinc, a strong discharge will leave it, and the sum of the three weak discharges is exactly equal to that of the strong one.

The rationale of these experiments appears to be this: each metal when in contact with water becomes oxidised, at the same time giving off electricity to the water, and lowering its own tension thereby; as soon as a certain specific difference of tension is attained, either by the fall of that of the metal or the rise of that of the liquid, all action ceases, and a fragment of zinc under this condition remains as unalterable as gold; the degree of inequality necessary is different with each metal, varying apparently according to its affinity for oxygen. If while a piece of zinc is in this negative condition a plate of copper or platinum be placed in contact with it, and also with the water or earth, a channel will be formed by which the deficient electricity in the zinc can be perpetually restored, the oxidation again goes on, and a current will consequently continue to pass from the water through the copper to the zinc until the whole of it is dissolved; if the plate of copper be in connection with the zinc through a wire, it will still serve to restore continually the electrical equilibrium, even although the plates be a thousand miles asunder. Any inoxydisable conducting matter will serve this purpose as well as copper, such, for example, as carbon; or an inert conducting liquid may be used, and we then have the well-known galvanic arrangement of a single metal with two dissimilar liquids. Although we have only been considering negative effects, it will be easily seen how the same action produces positive electricity; if a plate of zinc be connected with the earth by a wire, and a piece of moistened cloth be placed upon it, the zinc oxidises, giving its electricity to the liquid, and raising its tension until the specific difference is attained, and the action ceases; if a piece of platina be laid on the moistened cloth it acquires the same tension as the liquid, and forms a convenient collector of the positive electricity; and it may, in like manner, have a second piece of zinc and cloth laid upon it, each series raising the tension of the one above it one specific degree above its own tension, and the whole constituting the ordinary voltaic pile.

THE TELEGRAPHIC INVENTIONS OF PROFESSOR HUGHES.

ONE of the most recent amongst the gracious acts of the Emperor of the French has been the decoration of Mr. Hughes, Professor of Physics at the University of New York, with the Cross of the Legion of Honour. We subjoin a few details on the system and apparatus of the learned Professor. Professor Hughes' system consists of the production of any species of letter by means of a single current, whereas other essays at telegraphic printing rendered the use of a large number of wires, or a multiple operation for the transmission of each character, absolutely necessary. The French Government, perceiving at once the value of this bold idea, desired to possess the exclusive rights of the inventor, and caused several of Professor Hughes' apparatus to be placed on its lines. They soon, however, discovered that the invention, in its pecuniary condition, was not practicable, and Professor Hughes was requested to endeavour more fully to develope his discovery. With the valuable aid of the celebrated maker, M. Froment, Professor Hughes so successfully altered his instruments that he was enabled to transmit signs of punctuation and figures, which he had not previously done. Since that time the invention of Professor Hughes has been used with the greatest success by the Administration. It is in operation between Paris, Havre, Lille, Bordeaux, Lyons, and Marseilles, forty words being printed in a minute at an average rate of fifty messages per hour. The services of Professor Hughes are not confined to the above alone. The learned Professor, after careful study, has established the laws by which the magnetic fluid distributes itself in the electro-magnets, and the rules to be observed to obtain the maximum force. He has shown that every quantity of iron added to an electro-magnet above that which corresponds to this maximum diminishes its energy in the most perceptible manner. This discovery will, it is very clear, considerably diminish the cost of the batteries now used by telegraphic companies; in fact, Professor Hughes has succeeded in working a circuit of 1,000 kilometres with a battery of two cells, the one formed of copper, the other of zinc, divided by a little water. The Professor's inventions will shortly form a special subject in a pamphlet for the information of the scientific world and the makers of instruments.—*Le Moniteur Universel du Soir*.

THEORY OF THE CONSTITUTION OF THE SUN.—The following is a *resumé* of a long memoir on this subject by M. Emile Gautier, in the *Bibliothique Universelle*, in which he gives an account of the principal observations and theories that have hitherto been published:—1. The sun is a liquid incandescent globe, constituted of elements similar to those which enter into the composition of the earth, and probably into that of the planetary system. It exists in a state analagous to the phase of liquidity through which the earth has passed, according to the opinion generally entertained by geologists. The high temperature by which its liquidity is maintained considerably dilutes its volume, and explains the feeble relative density of the globe in a state of fusion. 2. An atmosphere envelopes the liquid mass, and encloses in suspension vapours or emanations of all kinds, so that its lower strata ought to be comparatively heavier than those of the terrestrial atmosphere. As the rotatory motion of the central globe cannot be supposed to be transmitted to its gaseous envelope, so far as its most elevated limits with the same angular velocity, the solar atmosphere is probably susceptible of exercising on the liquid surface an action analogous to friction. 3. The emanations or metallic vapours surrounding the sun, and impregnated with dust, smoke, or lava, form around it a layer of variable thickness, and present total eclipses, the appearance of red borders, and protuberances. The solar dark spots are partial solidification of the surface, due either to cooling or to chemical action, remitting momentarily into aggregates salts, or oxides, which have issued from the mass in fusion, and float on its surface. 5. The faculæ (bright spots) are the result of the appearance on the sun of very brilliant substances endowed with great radiating power 6. The acceleration observed in the rotatory movement of the spots situated near the solar equator is the result of the exterior action of the atmospheric pressure on the liquid surface, combined with that of the interior layers of the mass in fusion. Accidental irregularities may proceed from the disturbance of the chemical and physical equilibrium of the various materials composing the mass.

MALTA AND ALEXANDRIA TELEGRAPH.

THE following is an Account of the Number of Messages forwarded each way by Line of Telegraph between Malta and Alexandria, printed by command of the House of Commons, distinguishing Government and Private Messages, and the Local from the Through Traffic; and of the Gross Receipts from all Sources, from the Opening of the Line, 1st November, 1861, to 31st December, 1863:—

DATES.	Number of Government Messages.	Number of Local Messages.			Number of "Through" Messages.			TOTAL Number of Messages.	Gross Receipts of the Line.		
		Outwards (Malta).	Homewards (Alexandria).	TOTAL.	Outwards (Malta).	Homewards (Alexandria).	TOTAL.		£	s.	d.
1861: Two months—November and December	27	820	479	1,299	217	99	316	1,615	3,142	15	0
1862: Three months ending— March	75	1,552	1,095	2,647	551	283	834	3,481	6,853	5	6
June	82	1,614	1,092	2,706	720	450	1,170	3,876	7,941	0	0
September	25	1,719	1,044	2,763	973	707	1,680	4,443	8,484	13	0
December	97	2,786	2,026	4,812	888	682	1,570	6,382	11,958	13	6
First Year of the Lease	306	8,491	5,736	14,227	3,349	2,221	5,570	19,797	38,380	7	0
1863: Three months ending— March	76	2,572	2,068	4,640	919	601	1,520	6,160	12,047	2	9
June	75	2,715	1,857	4,572	912	588	1,500	6,072	11,429	1	0
September	36	1,998	1,317	3,315	511	670	1,181	4,496	7,106	3	2
December	68	4,860	3,860	8,720	1,627	992	2,619	11,339	21,560	2	4
Second Year of the Lease	255	12,145	9,102	21,247	3,969	2,851	6,820	28,067	52,142	9	3

A statement of the costs of the repairs of the line has been submitted to the arbitrators under the terms of the lease; but as no award has yet been given, we are unable to furnish the account required.

23, Great George Street, S.W., May 10, 1864. GLASS, ELLIOT, & Co., Lessees.

CAPTAIN AND MR. SPRYE'S PROPOSED OVERLAND TELEGRAPH TO CHINA ACROSS EASTERN PEGU FROM RANGOON.*

THE extension of the Indian telegraph wires now existing in Eastern Pegu *by land* to Hong-Kong, &c., if not directly beneficial to the Government of India in communicating with that more eastern part of the world, must prove most advantageous to all the merchants of India having connection with the trade of Eastern China and Japan; and certainly such an extension of the Pegu wires must very greatly increase the usefulness and income of the telegraph lines of India generally, since all messages by it between Europe, India, and China will pass both ways, from one point or another, through the Indian wires.

Passing by for the present the completion of the Indo-European line down the Persian Gulf, we will observe that on the arrival of the English mail steamers at Galle from Suez, long bulletins of news are now telegraphed to Calcutta, 1,380 miles, in three hours at the utmost. From Calcutta such messages can be passed on by the existing wires to Shwaygyeen, in Eastern Pegu, in less than two-thirds of that time, the distance being under 800 miles; but allow for it two hours. From Shwaygyeen to Sz-mau, or Ez-mok (in the Yunan province), the south-west frontier town of China proper, is *the first division* of this proposed extension of the Indo-European wires to China, through the Burman Shan cities of Kiang-Tung and Kiang-Hung, along the existing Chinese caravan road which passes through them from Sz-mau to the more western Burman Shan city of Moni. And from Sz-mau to Hong-Kong, through the principal cities and towns of the Chu-Kiang, or Pearl and West River vallies, by either of the two main Imperial roads, is *the second division* of this very important and well-considered extension of telegraphy in the far east.

The distance from Shwaygyeen to Hong-Kong by that long-established and well-travelled route is about 1,475 miles, over which the wires will certainly carry forward such a message in about three hours. This will make eight hours and a half only for a long Government despatch between Galle and Hong-Kong. But allow even one hour and a half additional, in all ten hours, and the message will reach Hong-Kong from Galle in less time than the steamer takes to coal there, and *vice versâ*, thus anticipating the steamer's arrival at Hong-Kong by seventeen days, and overtaking her at Galle, on the homeward voyage, with the same number of days' later news from China.

Surely such an increase of the value and usefulness of the Indo-European telegraph, obtainable by comparatively so short a *land* extension of it, cannot be deemed undesirable, or undeserving of the prompt earnest support of both the Home and Indian Governments. Russia has extended her wires from Europe, through Siberia, to Novgorod, at the mouth of the river Toumen, in the Sea of Japan, and has still further developed her course of foreseeing policy and aggrandizing action in those distant waters by her designs upon the Japanese islands of Tsu-sima and Fatchu,* commanding the Strait of Corea. To these isles Russia has laid a telegraphic cable from Novgorod, not merely for rapid communication with the arsenal she is there forming, but also with St.

* See their official letter to the Secretary of State for India in Council of the 20th of January, 1863, printed in their private pamphlet V., "On the Commercial Opening of Western China, Overland from Rangoon."

* These two islands stand in the centre of the Strait of Corea, close to each other. Tsu-sima, the most northerly, is 45 miles long and 12 broad; while Fatchu is 15 miles long and 10 broad. The channel between them forms a magnificent harbour, and has a town on its shore with 30,000 inhabitants. Both the islands are otherwise well peopled, and abound with the luxuries as well as the necessaries of life. By fortifying Capes Aniva and Crillon, at the southern extremity of the Isle of Sakhalin, so as to command the Straits of La Perouse and of Sungar, both of which are now within her power, Russia will close the Sea of Japan and Gulf of Tartary against the world, and hold exclusive naval and military command of the entire western sea-borde of the Japan isles. The island of Quelpaert, on which we are *stated* to have had a military and naval station since 1847, in no way interposes against Russia in the direction here indicated; because Quelpaert lies considerably south and west of Fatchu and the Strait of Corea.

Petersburg, from the Japanese and Chinese outer waters generally.

The first two divisions of the proposed extension of the Indian wires to China—Shwaygyeen to Hong-Kong—being successfully constructed and in work, *the third division* will come to be entered upon—viz., from Hong-Kong to Shanghai. Carrying the wires through the open ports of Amoy, Foo-choo-foo, and Ningpo, and the principal cities and towns along that route, the distance would be about 850 miles: the telegraphic gain in time between Galle and Shanghai becoming full twenty-two days. And this *third division* accomplished, it will then remain to extend the wires still onward from Shanghai to Hankow, Tien-tsin, Pekin, and even Japan, as may promise to be most useful and remunerative, in reference to the support her Majesty's Government may give to the undertaking.

Of the portion of the Indian telegraph set up in the province of Pegu, the Commissioner stated in his annual reports of that province for the two years 1859-60 and 1860-61 as follows:—"There are two lines of telegraph in the province having eight stations—viz., one line from Rangoon, north-westward to Henzada, Mengyee, Prome, and Thayetmyo; the other line north-eastward from Rangoon to Pegu, Shwaygyeen, and Tonghoo. The first line measures 242 miles, and the second line 191 miles, making a total of 433 miles. The messages sent in 1859-60 were—Government, 2,071; and private, 6,853; the receipts for the former being £509, and for the latter £1,163: total, £1,672; while the total expenditure for the year was £5,806, or £4,134 in excess of the receipts." For such an unfavourable financial state of the Pegu branch of the Indian telegraph the province itself will never afford a remedy. This can only be found in the extension of its wires beyond it. And on this head the Commissioner at the same time thus wrote:—"During the passing year a line has been set up from Prome, in Western Pegu, across the Arracan mountains, to Sandoway, on the Bay of Bengal, a distance of 114 miles; and continued thence, by the island of Ramree, to Akyab, to bring the Pegu wires in connection with the telegraph of Calcutta and India generally; and there is no doubt that this junction with the Indian Imperial lines will cause some increase in the utility, and consequently in the receipts, of the Pegu lines."

Again it may be asked, how very much greater must not be the increase of that utility, and of those receipts, when these lines are extended eastward from Shwaygyeen to Hong-Kong, and to the other before-named important places of commerce in the "far east?"

The increasing importance of these propositions as regards commerce, united to their perfect soundness, must, ere very long, command the serious consideration of a British ministry. For, unlike some projects which have in late years received Government patronage, and are still sustained by it, what is here proposed is really honest in itself, simple in its character, inexpensive to execute, easy to preserve in working order, and so manifestly for the public good, that official action in it, if properly directed, can neither involve waste of the public money or ministerial discredit.

TAR AND INDIA RUBBER.

THE following extract from the important Report of Professor Miller, F.R.S., on the constitution of, and the effect of various solvents upon, virgin and masticated India rubber will be read with interest at the present juncture, when it is alleged that the application of tarred hemp to an India rubber insulated wire has promoted its destruction. These experiments were mostly made in our presence.

Experiments in Caoutchouc.

The caoutchouc of commerce is, like gutta, not a pure vegetable principle, and consists of a hydrocarbon of definite composition, mixed with a small quantity of resin, the amount of which varies in different specimens.

The following are the results of my analysis of a sample of pure unmanufactured Para rubber, compared with a sample of good sheet masticated or manufactured rubber.

	Virgin.	Masticated.
Pure caoutchouc	96·6	96·64
Moisture	1·3	0·82
Resin	1·8	2·06
Ash	0·3	0.48
	100·0	100·00

Or, deducting moisture and ash, its elementary composition gave—

	Virgin.	Masticated.
Carbon	85·82	85·53
Hydrogen	11·11	12·06
Oxygen	3·07	2·41
	100·00	100·00

Caoutchouc, like gutta-percha, is, as already stated, liable to deterioration, by exposure to the action of oxygen in the presence of solar light, but the gum is less rapidly injured if exposed to their influence in the native state, than if it has been previously masticated. When subjected to the action of air excluded from light, it does not experience any marked change, even during very long periods. It is, however, important to observe that the masticated rubber is much more porous than the unmanufactured caoutchouc. When immersed in water, caoutchouc absorbs a much larger quantity of this liquid than gutta-percha, and the masticated much more than the unmanufactured or virgin rubber. I subjoin the results of my examination of some samples submitted to experiment by Mr. L. Clark.

Virgin Para Rubber, finest quality.

500 grains of this was exposed in each experiment, in the form of a narrow tape-like strip of rubber, which had been stretched while hot and suddenly cooled. It was of a very pale brown colour. The various samples were submitted to experiment at the end of October, 1859, and were examined nine months afterwards (August 4, 1860).

No. 1, which had been exposed in netting, in the open air, to sun and rain, had become blackened and rotten, but was neither sticky nor crumbled, had increased in weight 34·5 grains, or 7 per cent.

No. 2 was exposed in the air and light, but kept dry in a bottle placed mouth downwards; it had increased in weight 14 grains, or 2·8 per cent. by absorption of oxygen, and had become brown, soft, and sticky, especially in the parts most exposed to light. It gave up 11·81 per cent. of an oxidized, soft, and viscous resin to alcohol. The annexed analysis will give an idea of the composition of the resin thus formed:—

Carbon	67·23
Hydrogen	9·54
Oxygen	23·23
	100·0

The proportion of oxygen differs a little in different samples.

No. 3, which was exposed to diffused light in fresh water in an open bottle, had become white and opaque from the absorption of moisture, and had increased 86 grains, or 17 per cent., but it had experienced no other alteration in chemical properties, and when dried resumed its original characters.

No. 4, exposed in sea water in an open bottle to diffused light, had absorbed 3·6 per cent. of its weight of water, but was only a little altered in appearance, not in chemical composition.

Masticated Rubber, Sheet, best quality.

A similar series of experiments was made simultaneously upon masticated sheet caoutchouc.

No. 1, exposed to sun and rain, had collected into a sticky mass, which had lost its tenacity and elasticity.

No. 2, in the inverted bottle exposed to diffused light and air, had increased in weight 8 grains or 1·6 per cent., and had collected into a lump, which was viscous, and had lost its elasticity, especially in the parts most exposed to the action of light. When treated with alcohol it was found to yield 12·64 per cent. of its weight of resinous matter to this solvent. These changes were in marked contrast to No. 3, which was kept in a glass bottle in the dark for the same period, but exposed to the air freely. It had increased in weight only 0·6 per cent., did not show any sign of alteration in tenacity or elasticity, and yielded to alcohol 2·0 per cent. of resin only.

No. 4, a sheet of the same rubber immersed in fresh water, open to the air and diffused light, had increased 87 per cent. by absorption of water, that is to say, it had nearly doubled its weight. It had become white, opaque, slimy, and sticky when pressed, and allowed water to be squeezed out by pressure. It lost weight rapidly by drying when exposed to the air.

No. 5, similar to the last, but exposed in sea water. It was slightly opaque and slimy, but had increased only 5 per cent. in weight by absorption. A second sample, in sea water in a closed

bottle, emitted a smell of sulphuretted hydrogen, and had gained 5·6 per cent. in weight by absorption. Its elasticity and tenacity were not impaired. The gradual permeability of masticated caoutchouc to water was further strikingly shown by enclosing a quantity of acetate of potash in bags made of sheet rubber and accurately sealed. They were then immersed in water, and at the end of nine months the salt in each of the bags was found to have become liquified by the water which it had absorbed, and the bags had in each case gained in weight several grains.

A similar Series of Experiments was made with Sheet Rubber, vulcanized.

1. The sheet exposed in the netting to the sun and rain had lost 2 per cent. in weight; it was scarcely less tenacious than at first.
2. A similar sheet in fresh water absorbed 19 per cent., but was not otherwise altered.
3. A similar sheet in sea water was rather more slimy and had only gained 1·6 per cent. in weight.

Each of the three substances, viz., natural, masticated, and vulcanized rubber were submitted to the action of the following solvents for nine months:—

A. Boiled linseed oil.
B. Unboiled linseed oil.
C. Stockholm tar.

The *virgin rubber* had resisted the action of the solvents almost perfectly, retaining its toughness, excepting in those parts which were above the surface of the liquid and exposed to light. In the tar this rubber had contracted spontaneously, but was still strong and elastic.

The *masticated rubber* was in each instance greatly swollen and gelatinized, and indeed in the case of the unboiled oil was completely dissolved.

The *vulcanized rubber* had also lost its tenacity, and had become swollen and gelatinous, but retained its form and a certain degree of elasticity.

A sample of India rubber cable (from Captain Galton), which contained six strands of copper wire, each coated with rubber, then bound round with tape and again with rubber, had experienced a singular change, having become, *where in contact with the wire*, quite glutinous and sticky. This change, however, did not progress in the specimen which I kept for some months in my room, but the viscosity on the contrary gradually diminished.*

REPORT OF THE ASTRONOMER-ROYAL TO THE BOARD OF VISITORS OF THE ROYAL OBSERVATORY, GREENWICH.

(Concluded from page 30.)

IX. Magnetical and Meteorological Instruments.—I have stated above that the excavation for the new magnetic basement was begun on January 25 of the present year. It is unnecessary to say that the observations of declination, horizontal force, and vertical force were at once suspended, and my remarks on the operation of the instruments apply only as far as January 25. All have been in excellent order. The vertical-force magnetometer still exhibits sometimes the "dislocations" in the photographic trace. There is no evidence, I believe, that these dislocations do not exist in the curves of every vertical-force instrument, for they are always accompanied with vibration; and no vertical-force instrument, I believe, except that of Greenwich, gives a trace strong enough to exhibit vibrations; and the dislocations, therefore, with any other instrument would appear merely as interruptions of the trace, and would not attract much attention.

In the preparations for mounting the instruments in their new location the following points are worthy of remark:—

The declination-magnet in the magnetic basement (a new 2-ft. magnet by Mr. Simms) is carried by a pier built of brick and slate, whose upper part, or suspension-piece, protrudes through the floor of the upper room, for the sake of giving greater length to the suspending-wire, and for making the suspension-piece more accessible. This instrument is used for photographic self-registration only.

Upon the superstructure of this pier is planted the original framed wooden stand for carrying the original 2-ft. magnet vertically above the photographic magnet. Hitherto this magnet has been so mounted that its attached collimator was right or left of it; it is now so mounted that the collimator is above or below it; and with this arrangement, on reversing the collimator, and giving the necessary movement for making the collimator-axis coincide with the axis of the theodolite-telescope, the magnet is still vertically above the photographic magnet in the basement.

The theodolite, with which the magnet-collimator is viewed, and with which circumpolar stars are also viewed, is in the same position as formerly; a brick pier being built up from the ground below the floor of the magnetic basement, through the basement, and through the floor of the upper room, to carry the theodolite.

For the support of the horizontal-force magnet a pier is built of brick, stone, and slate, which, like that of the declination-photographic magnet, projects through the upper floor into the upper room.

The suspending cords of these three instruments are of steel wire. I have seen no practical reason for objecting to the silk skeins; yet, on theoretical grounds, I have long since determined, when opportunity shall present itself, to make this change.

The new vertical-force instrument differs from the old one in the following points:—First, the length of the magnet is 18 inches instead of 2 feet; secondly, its ends are pointed—a construction indicated by Lamont as giving great magnetic power—which, however, is not successful in the present instance; third, the knife-edge is one continuous piece of steel; fourth, the whole of the frame which connects the knife-edge with the magnet is of iron. I am not able yet to say whether any practical advantage attends these modifications.

The new positions of the vertical-force and horizontal-force magnets are vertically below their former positions. That of the declination-magnet is about ten inches north of its former position.

I have now to mention a result of late observations which has given me great anxiety.

The variations in the power of the horizontal-force and vertical-force magnets depending on temperature were determined, several years ago, with very great care, by experiments in which the magnet was immersed in water of various temperatures. It is evident, however, that this form of experiment does not exactly reproduce the circumstances of a magnet whose temperature depends on that of the external atmosphere; and I have long contemplated experiments in which the magnet should be heated, not by water, but by air.

Opportunity seemed to be given by the command of the hot-air stove, constructed entirely of copper, and heated with gas, which was provided for the warming of the magnetic basement. I had a copper box prepared to fix on the top of this stove, containing facilities for the placing of the magnet (to be tried) in a definite position, for the distribution of the heated air over its length, and for reading three thermometers in different parts of its length. The degree of heat was regulated merely by turning the tap of the gas-pipe at the floor—a manipulation which could not affect any part of the apparatus. The stove was placed in a position convenient for producing deviation, by the magnet enclosed in the copper box, on the needle of the Kew unifilar.

The result of these experiments is, to give a co-efficient for temperature-correction four or five times as great as that given by the water-heatings. And this applies to both the magnets (horizontal force and old vertical force), in which I am able to compare the two systems of experiment. A large co-efficient is also given for the new vertical force magnet, though much smaller than that for the old one, when tried in the same manner.

I cannot discover any peculiarity in the apparatus which can produce the smallest error. The only differences between the modes of action in the two experiments are, that in the former, or water-experiments, the magnet was "end on" to the deflected magnet, while in the latter, or air-experiments, it was "broadside-on;" and that in the former experiments the magnet travelled round to a position definite with regard to the axis of the deflected magnet (in which case its power is measured by the sine of deviation), whereas in the latter it was stationary (in which case its power is measured by the tangent of deviation).

For the rotating cylinders upon which the photographic paper is placed, and which have hitherto been of glass, being merely glass shades selected with great care from the large stock of a vendor of glass ornaments, I propose to try ebonite. This material is very light, but is firm; it turns well in the lathe, and presents a very smooth surface. I expect that a little accuracy will thus be gained in the sub-divisions of the time-scale on the photographic sheets.

The Kew deflexion instrument is in good order, but with the same defect of plan which I described in my last Report, and which I have not had time to remedy.

The dip-instrument, and all its needles, are in good order. With regard to its needles, and to dipping-needles in general, and the change in the position which they take upon being merely raised and lowered, I suggested in my last Report that there appeared to be a small wandering of the magnetic axis (produced, I suppose, by the infinitessimal jar of raising and lowering the needle), and that the injurious effects of this might be removed if the breadth of the needle, instead of being in the plane transverse to the axis of rotation, were in the plane passing through the axis of rotation. I have accordingly had three needles prepared by Mr. Simms in this form, of the lengths three inches, six inches, nine inches respectively (the same lengths as those of the other systems of needles), with the same dimensions of axle and the same workmanship as in the other needles. And very lately I have had a numerical comparison made between the extreme discordances of the field-of-view readings of the needle-points (the microscopes remaining unmoved) produced by raising and lowering the needle usually five times,

* The quantity of viscous matter was too small to admit of satisfactory analysis. I ascertained, however, that no copper was present in the viscous mass, and that the wire was not corroded. I could not determine whether grease was present in small quantity, as was not unlikely.

sometimes four or three times, but as nearly as possible the same number of times in each class. The results are as follows:—

		Largest Values of Daily Mean of Extreme Value of Discordances, in Groups of 5, &c.		General Mean of Extreme Discordances, in Groups of 5, &c.	
9-inch needles	B_1 ordinary	19′	14″	8′	45″
	B_2 ordinary	12	14	8	45
	B_4 new flat	4	5	2	20
6-inch needles	C_1 ordinary	48	32	27	52
	C_2 ordinary	21	35	9	53
	C_4 new flat	7	12	3	36
3-inch needles	D_1 ordinary	12	21	7	56
	D_2 ordinary	14	6	7	24
	D_4 new flat	8	49	4	26;

and, combining the needles of different lengths but of the same class, the means of extreme discordances are—

For an ordinary needle	11′	45″
For a flat needle	3	27

It appears here that the greater part of the discordance is owing to a cause peculiar to ordinary needles, as distinguished from flat needles (which cause I still attribute to inconstancy in the position of the magnetic axis), whose action cannot be annihilated. After this I need not say that I consider it certain that the small probable errors which have been attributed to ordinary needles are a pure delusion. I know no instrumental determination in which, without any breach of faith, the wish for uniformity of results will be so certainly followed by uniformity of results, as in the determination of dip. I am proud to offer to the world the long series extending from 1843 to 1864, as one in which this wish has nowhere prevailed, and which I believe exhibits the genuine results of unbiassed observations made with the most accurate instruments that anxious care and the best mechanical skill could produce.

The self-registering apparatus for the record of results of the earth-current wires is ready in all important points, but its mounting is delayed for the completion of the magnetic basement.

The meteorological apparatus is in good order. Some of the instruments —the barometer, the dry and wet thermometers, the anemometers, and a pluviometer—are adapted (like the three magnetometers) to automatic continuous register as well as to occasional eye observation. Other instruments —as several pluviometers at different elevations—exhibit accumulations to be occasionally read by eye. Others—as the maximum and minimum thermometers in the air and in the Thames—register extremes only, and require to be read every day. The electrometers (which communicate with a wire that extends from a warmed glass pillar upon the electrometer mast to a warmed glass pillar upon the north-west turret of the octagon room) are only useful when the eye is turned towards them; until satisfactory means of self-registration can be arranged, these instruments are nearly useless.

I am preparing to erect near the entrance-gate of the Observatory a barometer for public information. Only the graduated face will be exposed. Upon this the scale of graduations will be much enlarged. Indexes are arranged for exhibiting the present state of the barometer, the last maximum, and the last minimum.

X. Magnetical and Meteorological Observations.—The barometer and dry and wet thermometers are read several times every day, and the maximum and minimum thermometers once every day, to the present time. The eye observations and the photographic record of the three magnetometers have necessarily been suspended since January 25, but the photographic record of the barometer has been continued to May 10, and that of the thermometers is still maintained. Dips have been observed twice each week, or oftener. Observations for absolute measure of horizontal magnetic force about three times in a month.

In the present year, commencing with January, 1864, sixty series of observations on twenty-three days have been made with the actinometer.

With the gratuitous assistance of the London District Telegraph Company and the Submarine Telegraph Company we every morning communicate to M. Le Verrier the state of weather and the readings of barometer and thermometer, which, with those from other parts of Europe, are published in the bulletin.

XI. Reduction of Magnetical and Meteorological Observations.—The equivalents for eye observations of the three magnetometers, and the temperature corrections for two, are applied as far as the suspension of photographic records on January 25; the reading for astronomical meridian is reduced and applied to December 31, 1863. The time-scales are attached to the photographs as far as December 31, 1863; the new baselines for the declination and horizontal force to June 30, 1863, for the vertical force to December 31, 1863. The deflection observations are reduced to December 31, 1863. The dip observations are reduced to the present time.

The mean magnetic declination for 1863 is about 20° 46′; the diminution from the preceding year about 6′. The mean dip for 1863 is about 68° 4′. The diminution from 1862 appears to be about 7′. The dip at the present time appears to be 68° 2′; but this depends partly on C_1, which always gives a large result. It is remarkable that this is the needle whose magnetism, as above stated, appears to be so unsteady.

The barometer-photographs are in the same state as the vertical-force photographs upon the same sheet, to the end of 1863. No step of reduction is taken for 1864.

The thermometer-photographs are nearly in the same state.

The vane of Osler's anemometer made about +28·5 complete revolutions in the year 1863; the largest number that we have yet observed.

In the last report, I alluded to the numerical discussion of the magnetic storms, 177 in number, registered from 1841 to 1857; the treatment of which was then far advanced. In the last autumn, I finished the discussion of these: the results have been placed before the Royal Society, and are printed as a memoir in the Philosophical Transactions. They appear to me entirely to support the idea that storm-disturbances cannot be explained by sudden magnetic attractions or sudden galvanic currents, but require the supposition of currents, like air-currents or water-currents, upon the surface of the earth.

XII. Printing of Magnetical and Meteorological Observations.—I have thought it desirable to commence the printed record of the observations of 1862 with an introduction at considerable length. The last detailed introduction is that in the volume for 1847 (the last separate volume of detailed magnetic and meteorological observations); and, though changes in instruments and methods have been noted in the briefer introductions preceding the "Results of Magnetic and Meteorological Observations" attached to the Astronomical Observations, yet it appeared advantageous now to collect the results of all, and to exhibit fully the present state of the magnetical and meteorological establishment. The manuscript is in the printer's hands, and the printing is in progress.

The indications of the magnetometers are printed in the same form as in preceding volumes commencing with 1847; exhibiting the numerical values, expressed each by its proper scales, of the ordinates of all the salient or conspicuous points of each photographic curve. The printing of these is very nearly finished for 1862. The other magnetic observations are prepared for printing in different degrees of detail; the manuscript is in the hands of the printer. An appendix contains the abstract of the reduction of the observations of magnetic storms (to which I have alluded above) in a form intermediate between the exhibition of instrumental indications and the analysis in the Philosophical Transactions; the printing is far advanced. The meteorological observations for 1862, in abstract only, are printed.

As the long introduction, and the storm abstracts, increased the size of this portion of our printing, I have deemed it expedient, for 1862, to direct that it be bound in a separate volume. The number of copies is 600, of which I propose that 350 be considered as a second part of the astronomical volume, and that 250 be circulated separately as heretofore.

For 1863, the indications of declination magnetometer are prepared to Feb. 26, those of horizontal force to May 31, and those of vertical force to July 31. The meteorological abstract is more than half finished; the following tables nearly complete.

It is known to the visitors that I have every year prepared photographic copies of the photographic curves, for future use or communication to others. These copies can only be formed by the transmission of sunlight through the originals, and, in order to give the desired vigour and clearness to the copies, it is often necessary to touch the originals with sepia or other dark pigment. It has been matter of great regret to me that the delicacy of the original is frequently much injured by this process. I have at length devised a method which removes all difficulties. An apparatus is constructed, consisting of a horizontal looking-glass and a sheet of clear glass erected over it in the position of a desk. The photographic sheet is laid upon this desk with its face downwards; the photographic curve is seen in the utmost perfection by light reflected from the looking-glass and transmitted through the paper; and the sepia is laid on the back of the paper, without touching the original photographic trace at all.

Two copies of each of the photographic curves for declination and horizontal force have been taken to December 31, 1861, and two for vertical force to April 30, 1862.

XIII. Chronometers, Communications of Time, Longitudes, &c.—The number of chronometers on hand at the date of this report is 168; of these, 101 are the property of Government, and 67 are on the annual competitive trial. The whole of the latter and a portion of the former are compared every day with one of the galvanic clocks, sympathetic with the normal mean-time clock; the remainder are compared with it once every week. Every chronometer is tried for some weeks in the heat of the chronometer oven.

All decisions on the merits of chronometers offered to the Government for purchase, and on the merits of chronometers rated in the annual competitive trial, are referred to me; and the repairs of chronometers belonging to the Government are effected entirely through me.

The system of galvanic clocks (containing among others the normal clock, the chronometer clock, and the large clock at the entrance gate), are all simultaneously adjusted to time by the use, when required, of a galvanic force, which may be kept in action during any arbitrary time, to accelerate or retard the vibrations of the pendulum of the normal clock. Another common clock has lately been fitted with contact springs, to enable it to give the currents at every second when the normal clock is for a time disabled.

The time-signal-ball at Deal is dropped daily by a galvanic current automatically given by the normal clock; and from the first, very few

failures have arisen from defect in the observatory apparatus. Failures have usually arisen (and, in the late disturbed state of the South-Eastern station, more frequently than usual) from defects in the connexions of the railway telegraph. Time-signals are sent daily to great distances, as Glasgow and Cardiff, and on the principal railways in various directions. Time-signal-guns are fired daily at Newcastle and Shields. The Post-Office clocks are regulated mechanically, and signals are sent for regulating the Westminster clock; and all these, as well as the Deal ball, automatically report to us the success of the effect of the current which left the Greenwich clock. I shall advert below to the failure of my proposal for hourly time-signals on the start point.

In these various operations, about one-fourth of the strength of the observatory is employed. Viewing the closer dependence of nautical astronomy upon accurate knowledge of time, there is perhaps no department of the observatory which answers more completely to the original utilitarian intentions of the founder of the Royal Observatory.

I expect that, in the latter part of the summer, steps will be taken by Mr. Otto Struve for the telegraphic determination of the differences of longitude between Greenwich and some station on the Continent, and between Greenwich and some point near Milford, as portions of the great arc of parallel which is to extend from Orsk on the river Oural, to Valencia. The initiation of this enterprise was made by Mr. Struve, and much of the primary work was done by Mr. O. Struve. I hold it to be my duty therefore in no way to interfere with Mr. O. Struve's plans, but to place the observatory, and myself, and the influence which I may command among the telegraphic or other institutions of the country, entirely at his service, and, as a zealous subordinate, to take every possible measure for carrying out his design.

XIV.—Personal Establishment.—The persons employed as assistants are the same, and with the same ranks as at the last report; Mr. Edward James Stone, M.A., Fellow of Queen's College, Cambridge, is confidential assistant; Mr. Dunkin is charged with the altazimuth; Mr. Ellis and Mr. Criswick with the chronometers and time-work; Mr. Carpenter with the equatoreal, and with the care of manuscripts, library, distribution of observations, &c. Mr. Lynn, B.A., University of London, has the control of the supernumerary computers. Four or five computers are usually attached to the astronomical department. Mr. James Glaisher, F.R.S., second assistant of the Observatory, superintends the magnetical and meteorological department, aided by one assistant, now Mr. Nash, and by three or four supernumeraries.

I am ultimately responsible for every part of the work performed at or for the Observatory.

XV. Extraneous Work.—I have not, in the past year, sought for the Observatory any extraneous work, although in my own person I have found it difficult to avoid devoting a portion of my time to the assistance of the Government in some small matters applying to standards of measures and weights.

This, however, may be a proper place for referring to other works connected with the Greenwich observations. Mr. H. Breen, formerly assistant, but who had retired from the Observatory, desired to complete certain numerical investigations, and the Admiralty, after calling for my opinion on some points, have sanctioned the expense. The first was a re-determination of the moon's parallax, by comparison of the observations of declination made at the Cape of Good Hope, principally with those made at Greenwich, but partly with those of other British observatories; the results of this are printed in the memoirs of the Royal Astronomical Society. The second was a determination of the moon's diameter as inferred from occultations at Greenwich and Cambridge; the manuscript computations are still in my hands for revision, as soon as I can find leisure for that purpose. The third is a general reduction of Bradley's unpublished Greenwich observations from 1743 to 1750; the attested copy of the manuscript is lent to Mr. Breen for this purpose, and preparations for the calculations are begun, but no part except perhaps some auxiliary tables is yet actually computed.

XVI. General Remarks.—The visitors will doubtless have remarked that the hope which I expressed in my last report, of shortly bringing up the reductions to their usual state, has not been disappointed. The astronomical reductions have been brought up to a state more advanced than usual; the magnetical reductions are not quite so forward. This considerable advance upon the state of things in 1863 has been gained principally in consequence of our having no large extraneous work. Observations have been restricted where it could be done without loss of anything essential, yet the whole number of observations scarcely differs from that of the preceding year. The assistants have honourably used their best efforts to urge the work on in an orderly and rapid course.

The whole amount of labour in the year can scarcely be gathered even from such a detailed report as that which I have offered. The time consumed in reductions or comparisons connecting the past of Greenwich with the present; the correspondence with contemporaneous institutions; the responses to applications or inquiries of irregular character, by no means confined to astronomical, magnetical, or meteorological subjects; the preparations of new introductions, descriptions, or memoirs; the arrangements of manuscripts, books, and money accounts; and the general administration; occupy a far larger proportion of our time than could be conjectured by any person who has not had the experience of an establishment, old, active, and widely connected. The part of these labours which falls on myself has been felt in the past year as heavier than usual.

Before closing this report I take the opportunity of placing on record some plans of proposed action, which I am unable to carry out at present; but which, as I trust, with such modifications as experience may suggest, will be adopted for effectual use at some future time. They relate to the system of hourly time-signals proposed for exhibition at the Start Point.

It will be remembered by the Board of Visitors that, after consideration of the reasons which I adduced and the methods of galvanic communication and manipulation which I explained, the Board, at their visitation of 1862, deputed a selection of their members, accompanied by myself, to wait on his Grace the First Lord of the Admiralty, and to request his favourable attention to the proposal; and that in the course of the summer of 1862 an answer was received, conveying the substance of communications referring to this proposal which had passed between the Board of Admiralty and the Board of Trade, of which the conclusion was that the Board of Trade possessed no funds applicable to the defraying of the expenses attending the execution of the scheme. This answer was not laid before the Board of Visitors or known to myself till the visitation of 1863. As it did not fully explain the intentions of the Board of Admiralty, I applied to them in the autumn of 1863, requesting to be informed whether the Admiralty considered as possible the establishment of these time-signals under their own authority; and I received their reply that they do not at present contemplate that measure.

Trusting that the establishment of these signals is only deferred for a few years, and thinking it probable that advantage may result to the system which will hereafter be adopted, from a publication of some details of the plan on which I had proposed to act now, I will here state the general principles of the arrangement on which I had provisionally decided.

The Admiralty possess telegraphic wires passing underground from the Admiralty Telegraph-office in Whitehall through the principal street of Deptford, towards Deptford Dockyard, Woolwich, and more distant places. The Royal Observatory possess telegraphic wires passing from the Observatory to a house in Deptford called Gothic House, through which one of the Admiralty wires is led; and here, at any moment, such communications of wires can be made, that the galvanic currents from the Admiralty will all pass to the Observatory and back to Gothic House (by what is technically called "a loop"), and thence proceed towards Deptford Dockyard and Woolwich.

When an interruption is made at the Observatory, then currents can be sent direct from the Observatory to the Admiralty Telegraph-office.

The wire of the Deptford speaking-instrument in the Admiralty Telegraph-office can be joined with a wire of the Devonport speaking-instrument in the same office. The wire from the Telegraph-office to Devonport is continuous, and is good, liable only to some interruptions from occasionally receiving the spray of the sea beyond Exeter.

When these connections are made there is unbroken metallic communication from the Royal Observatory to the Admiralty-office at Devonport: sufficiently good to ensure the transmission of Greenwich signals with the regularity required for giving the information by which the Devonport superintendent can adjust his clock; and also sufficiently good to ensure the transmission of automatic signals from the Devonport clock to Greenwich, by which the officers of the Royal Observatory will see the error of the Devonport clock; but not sufficiently good to ensure the regular dropping of a time-signal at the Start, if wires should be continued from any part of the Devonport telegraph-wire to the Start.

The distance, however, from Devonport to the Start is so much less, that it may be expected that no difficulty will be experienced in dropping a time-signal at the Start by the agency of a galvanic battery and automatic clock at Devonport.

The first section, then, of the proposed operations must consist in such arrangements as will secure the accuracy of a clock at Devonport, and the second section must consist in such arrangements as will secure the accuracy (by automatic action of that clock) of the signal-drop at the start, and will also secure a register at Devonport (by automatic action of the Start mechanism) of the actual success of the signal-drop, in a form which will admit of convenient transmission to the Royal Observatory of Greenwich.

For the first section three arrangements are to be made:—1. About the time of each of the proposed communications from Greenwich to Devonport, or from Devonport to Greenwich (in all, three times or four times every day), for a few minutes at each time, an automatic clock at Greenwich must interrupt the Greenwich loop, and must connect the Greenwich Motor clock with the Deptford wire to the Admiralty; and an automatic clock at the Admiralty must interrupt the communications of that Deptford wire with its speaking instrument, and of one Devonport wire with its speaking instrument, and must connect the Deptford wire with the Devonport wire. 2. At the times arranged for signals from Greenwich to Devonport, the Motor clock at Greenwich must for an instant automatically take its wire from earth, and connect it with a galvanic battery. 3. At the times arranged for signals from Devonport to Greenwich, the Devonport clock must for an instant automatically take its wire from earth and connect it with a battery. All these arrangements are very easy, and their action is practically infallible.

The Devonport clock would probably require a small mechanical correction every day (to remove the error arising from unsteadiness of rate, which error the attendant would ascertain by observation of the Greenwich signals). This is best done, as at Greenwich, by fixing on the pendulum a magnet, of which one pole swings above a galvanic coil; a galvanic current, sent at

pleasure through the coil, produces attraction or repulsion, according to the nature of the current sent; and the clock is accelerated or retarded. The current must be kept in action till the clock error is perfectly corrected.

In this manner, it was presumed, accuracy would be insured in the state of the Devonport clock sensibly equal to that of the Greenwich Motor clock; and thus Devonport might be adopted as basis for the operations by which the Start time-signal would be actually dropped.

For the second section the arrangements would be the same as those between Greenwich and Deal. There must be a clock at the Start, by which the resident at the Start would be guided in order to raise the Start signal at the proper time before each hour; there must be a relay and a local battery; the Devonport clock, by mechanism similar to that of the Greenwich Motor clock, must automatically send a current accurately at every hour, which will work the relay and put the local battery in connection; and the action of the local battery must withdraw the detent on which the time-signal is lodged, and thus drop the signal; and the signal, shortly before reaching its lowest point, must (by what is called a "tapper-apparatus") so change the connections of the battery that an instantaneous current will be sent to Devonport. These arrangements are found, in practice, to work without failure.

It was proposed that the time-signal at the Start should be a skeleton-ball about eight feet in diameter, dropped through a space of twelve or sixteen feet. The locality selected for it is a rock behind the Start lighthouse, called "The Boy." The height of the mast on which it should be raised would be determined after inspection from the sea; but no great height would in any case be necessary. It was proposed to commence with day-signals only, but night-signals would be given by a mere change of galvanic communications at the Start, which would enable the galvanic current to drop a small weight, whose fall would fire a quantity of gunpowder sufficient to produce a flash visible at the distance of several miles.

For the Devonport record of the currents sent by the action of the tapper-apparatus at the Start the following mechanism was proposed:—The Devonport clock was to give rotation to a small barrel, perhaps three inches long and three inches in diameter, covered with paper. This barrel was to revolve in a time differing from 1h. by a small quantity, say by $\frac{1}{500}$ part, which would easily be given by the 60-minute spindle of the clock, carrying a wheel of thirty teeth acting in one of twenty-nine teeth, the latter wheel being fixed to one of thirty teeth acting in the barrel-wheel of thirty-one teeth. The Devonport clock also was to give slow motion by a screw to the frame carrying an indicator, which would be made to travel nearly from one end of the barrel to the other in twenty-four hours. That indicator would be made to impress a point on the barrel by the instantaneous current from the tapper-apparatus. It will be seen that the twenty-four signals given in the course of one day, if at perfectly uniform intervals, describe on the barrel a spiral very little inclined to the axis. Any departure from uniformity to the extent of three seconds of time would immediately be visible to the eye, and this would be sufficient to give evidence on the correctness of management of the ball. At the end of twenty-four hours exactly the barrel would have performed $24 + \frac{24}{500}$ revolutions. In preparation for the commencement of a second day the attendant must draw back the travelling indicator frame to the beginning of the screw, and then the indicator would in the course of the second day describe another spiral at the distance $\frac{24}{500} \times$ circumference of barrel from the former. This retraction of the indicator-frame is the only daily operation, referring to the register, which is required from the attendant. At the end of each month the barrel must be removed and replaced by another—the paper covering is then to be taken off and sent to the Astronomer-Royal. For the indicator I proposed to use a mechanism (suggested to me by Professor Wheatstone) in which the bottom of a small cistern of ink is perforated with a single hole, too small to permit the escape of the fluid ink; the action of the galvanic current thrusts a small wire through this hole, and the end of the wire carries a small film of ink, which impresses a dot upon the barrel-paper.

In selecting a course for the telegraph-wires from Devonport to the Start, it was proposed, under the advice of the best telegraph engineers, not to take the shortest line (which would be, to return towards London as far as the Kingsbridge-road station, and then to pass by an inland road directly towards Kingsbridge and the Start point), but to make use of existing poles to Newtown-junction, Torquay, and Dartmouth, from which place the extent of telegraph line upon new poles would be small.

The following collateral advantages would attend the establishment of this system of signals:—Accurate time-currents would be given at Devonport, which could be made subservient to the public exhibition of time-signals, either at Mount Wise or on the Devonport Column. A commencement would be made of coast-telegraph, available for military purposes. Facilities would be given for a commercial telegraph from the Start Point to Dartmouth, much desired by persons connected with the mercantile marine.

G. B. AIRY.

May 23, 1864.

SCIENCE HONOURED.—We find that M. Ruhmkorff has received the prize of Napoleon III. (50,000f.) for the finest application of electricity, on account of the induction apparatus which bears his name. He has also received the great gold medal of the order of merit from the King of Hanover.

CORRESPONDENCE.

SMITH'S ELECTRIC TELL-TALE.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—Your notice of Mr. Smith's Tell-Tale, in the *Telegraphic Journal* of the 16th, has been duly appreciated by me. You will, therefore, in future discontinue inserting my advertisements or forwarding the paper.—I remain, Sir, yours obediently,

J. SAX.

[We give publicity to the above letter, as it is distinguished by a candour in the expression of opinion seldom met with in these days of disingenuousness. Mr. Sax is at liberty to make what use he pleases of our notice of Smith's Electric Tell-Tale. It has always been our endeavour to faithfully represent telegraphy, and to make the *Telegraphic Journal* a record of electrical progress; it is, therefore, very encouraging to learn that our labours are "duly appreciated."—ED. T. J.]

INDIA RUBBER COVERED WIRES.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—The extraordinary, rapid, and utter failure of the twenty miles of india rubber covered cable, forwarded to India some three years ago, is a subject of immense importance at the present moment, when it is in contemplation to embark in extensive submarine undertakings. Great hopes were entertained at the time that the above cable would be the means of re-establishing confidence in the permanency of deep sea telegraphy, and not a word was said as to the plan adopted for serving the cable with tarred hemp. During the process of sheathing at Mr. Henley's works, indeed, the patentees suggested the saturation of the hemp sheathing with a composition of tar and cork, and a specimen of such a cable now lies before me. It is evident that the "MANUFACTURERS OF THE CORE" endeavour to fix upon Sir W. O. S. Brooke the responsibility of the failure. It appears to me unjust to do so. The following is an extract from a letter published by those gentlemen in March, 1863, in which there is no reference whatever to the tarred hemp:—

"After undergoing the testing, the core was forwarded to the works of Mr. Henley, North Woolwich, in order to be finished off with a sheathing of spiral iron wire—a process, by the way, which we consider highly injurious to any core of whatever material made." *No complaint of the serving with tarred hemp!* There can be no doubt but that this untoward event will greatly militate against the adoption of the material for submarine telegraph purposes—a material, if properly and skillfully treated, which possesses all the elements conducive to success.—I am yours, &c.,

A. J. T.

TAR AND INSULATING MATERIALS.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—As it appears that Stockholm tar is fatal to india-rubber insulation, I am curious to know what will be the effect of the large quantity of that material which is now being introduced between the insulating layers of gutta-percha in which the conducting wire of the Atlantic cable is enveloped. My experience leads me to denounce the introduction of tar as a component part of a gutta-percha core. The *invalid* which lingers between Malta and Alexandria affords an instance of the injudiciousness of employing tar when it is known that its insulating capacity only lasts for a brief period. I am informed that it is adopted simply because it is a cheap insulator, and may be depended upon for some weeks, at least as far as the contractor's guarantee extends. I hope that the few observations I have made will induce some of your readers to enlighten us upon the above, by no means unimportant, subject.

CATO FIDELE.

TAR AND INDIA RUBBER.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—One would have thought that the extensive experiments made under the direction of the Board of Trade by Professor W. A. Miller, Mr. Latimer Clark, and Mr. Owen Rowland, with the view of ascertaining the effect of various solvents upon gutta percha, india rubber, and other materials, would have rendered it improbable that such an eggregious error should have been perpetrated as to enclose a masticated rubber insulated wire in a serving of tarred hemp. I have looked over a communication addressed to a late contemporary by Messrs. Wells & Hall, and dated the 30th March, 1863, and no protest whatever is made against the enclosing of their India rubber core in tarred hemp sheathing. In fact, I believe that one of the patentees stated that there was no danger to be apprehended from the application of tar to the core manufactured by his firm, and I know that on a previous occasion tarred hemp was employed as a sheathing to a short length manufactured for Government purposes. It appears to me, Sir, strange that in telegraphy a conduct should be pursued by manufacturers so diametrically opposed to that adopted in other branches of industry. The manufacturers of the cable in question must have known, or at least ought to have known, that the enveloping of their core in tarred hemp must have proved fatal thereto. What says Professor Miller?—"The *masticated rubber* was in each instance greatly swollen and gelatinized, and indeed in

the case of the unboiled oil was completely dissolved." But then, again, what are we to say of the total destruction of the virgin rubber with which the wire was primarily coated in the above instance? I believe that the pure Para rubber (as it is called), in the cable manufactured for the India Government, of which so much has been said, was thoroughly gelatinized and its insulation completely destroyed, although Professor Miller's experiments appear to prove that the solvent powers of Stockholm tar did not affect the composition of the material in the least, as it did that of the masticated rubber as described. I write in no unfriendly feeling, but on the reverse, my object is to invite enquiry, which I believe must culminate in beneficial results to the science at large—"a consummation devoutly to be wished." In conclusion, allow me to express an opinion which I believe is generally admitted to be correct, namely that "Telegraphy is frightfully hampered by patents."—Yours truly,

18th July, 1864. OMICRON.

INDO-EUROPEAN TELEGRAPH.

To the Editor of the TELEGRAPHIC JOURNAL.

Constantinople, 11th July, 1864.

Sir,—I observe by your paper of the 25th ult., that you have inserted extracts from the Constantinople correspondent's letter to the *Daily Telegraph*, dated 9th of June, relative to the Indo-European Telegraph, &c. I therefore request you to be good enough to insert my reply thereto in your journal. Your early attention will much oblige, yours faithfully,

L. WALTER COURTENAY,
Commissioner to the Indo-European Telegraph.

To the Editor of the DAILY TELEGRAPH.

Constantinople, 9th July, 1864.

Sir,—My attention has just been called to a letter of 9th of June, from a correspondent at Constantinople, which appeared in your impression of 21st ult., and in which my name has been mentioned.

I should not have taken the slightest notice of the matter—the value of this attack, and the source from which it emanates, being locally well-known, and correspondingly appreciated—were it not, that the assertions, circulated in your widely diffused columns, at once acquire an importance which would not otherwise belong to them, and are calculated to mislead the public at home.

He states, that "Mr. L. W. Courtenay had applied for the use of an office in the European Telegraph Department; that this had been refused, and one had been offered at the Scutari office."

Now, inasmuch as the office destined exclusively for the reception and retransmission of the Indo-European telegrams, is according to Art. 6 of the Convention, to be quite separate from the present European Telegraph Department, and that, owing to technical difficulties, no decision has been as yet come to, as to whether such office is to be at Scutari, Stamboul, or Pera, nothing has been done in this question. No official application has been made, therefore no refusal can have been given. I have mentioned the desirability of my having an office in this special department to His Excellency Sir Henry Bulwer, in a memorial addressed to him, and lately *in conversation* to the Ottoman Director General of Telegraphs, and so far from being refused, no opposition whatever was made; the technical difficulties once removed, the special office will certainly be at Stamboul or Pera. In the meantime I have given up two rooms in my own house at Pera, and the only person inconvenienced is myself.

With regard to Mr. O'Connor, I am so fully convinced of his merits, that I have urged, and am still strongly urging upon the Ottoman administration, the expediency of his being appointed *their* superintendent of the special office above alluded to, in which capacity all the Indo-European telegrams will pass through his hands, and his long experience of the practical working of a telegraph office, and of the management of a large staff of "employés" in this country, will no doubt prove him to be the best man that could be selected. I have every reason to believe, that my representations in this direction will prove successful.

Your correspondent is further in error as to my being "traffic manager." I have been appointed "Commissioner" for the "Indo-European Telegraph," and my duties are altogether separate from those which Mr. O'Connor will have to perform, if appointed.

As throwing light upon the *animus* of the letter, I think it right to mention the fact, that your correspondent was employed by me for a short time as temporary amanuensis, and hence may have become superficially acquainted with the telegraphic details, which he has communicated to you, some of which are correct, or rather were so *three months* ago, but many of which are entirely inaccurate.

My name having been so prominently brought forward must be my excuse for troubling you with the above explanation, and I rely on your courtesy in affording it a space in your valuable paper.—I have the honour to remain, Sir, your obedient servant, L. WALTER COURTENAY,

Commissioner to the "Indo-European Telegraph."

AEROSTATIC RAILWAY.—From the *New York Sun* we learn that M. Gourand, vice-consul of France for Rhode Island, has made application for a patent for his aerostatic railway, to be worked by atmospheric force upon inclined planes of wire suspended in the air. It is proposed to apply it to street railways for crowded thoroughfares in populous cities.

TELEGRAPHIC NEWS.

ELECTRICAL FORCE.—At the Royal Society, on the 16th ult., Sir Snow Harris, F.R.S., communicated a paper detailing "further inquiries concerning the laws and operation of electrical force." In this paper the author endeavours to definitely express what is meant by *quantity of electricity, electrical change*, and *intensity*. He also enumerates formulæ, as embracing the general laws of quantity, surface, boundary, extension, and intensity, practically useful in deducing the laws of statical electrical force. We shall endeavour to lay before our readers the whole of this interesting paper shortly.

SPANISH CORRESPONDENCE.—The Submarine Telegraph Company gives notice that messages intended for places where there are no telegraph stations, must be addressed by post from the nearest known station, the use of "expresses" and "estafettes" having been abolished by the Spanish administration; and that messages containing the same subject-matter, addressed to more than one person in the same town, can no longer be delivered at a charge of sevenpence per copy. Henceforth each copy will be charged for at the same rate as that paid for the original message.

DAMAGE TO A SUBMARINE CABLE.—On the 17th inst., the brig Caroline of London, arrived in Ramsgate Harbour, and reported having damaged with her anchor the submarine cable lying between Dover and Ostend. On the following day she left Ramsgate for the purpose of picking up the cable, which has been successfully repaired. The Submarine Telegraph Company, in consequence of the frequent damages caused by ships' anchors on the Dover coast, had a short line carried from Ramsgate across the Goodwin Sands, and joined to the main cable between Dover and Ostend, about twenty miles from land; so that it is hoped that for the future these obstructions from anchors will be avoided. The whole business of the company is now being carried along the new line, and should any accident occur the old branch to Dover will be available.

W. F. COOKE.—We have to thank an esteemed correspondent for an interesting account of some pleasing festivities which took place recently at Castledeudraeth, in Merionethshire, North Wales. The festivities took place on the marriage of the eldest daughter of W. Fothergill Cooke, Esq., of Aberia-hall, in that county, to Major Andrews, of the R.A. Mr. Fothergill Cooke, we need hardly inform the telegraphic world, is the gentlemen to whom we are indebted for having practically introduced and carried out the electric telegraph. Our correspondent adds, that Mr. Fothergill Cooke is beloved as a liberal landlord, a generous master, and an excellent neighbour in his adopted country, where he has experienced complete restoration to health, after many years of severe illness. The children of the various schools in the neighbourhood were entertained upon the occasion with a liberal supply of good things, in commemoration of the happy event.

THE OCEAN TELEGRAPH COMPANY'S CABLE—A scheme is in course of realisation, under the direction of Captain Rowett, for connecting France with America by a submarine line. The following is the form of Captain Rowett's proposed cable:—Diameter, about one inch. There will be only one copper conductor, and this is to be imbedded in virgin india-rubber. Hitherto telegraph wires have been bedded in manufactured rubber, in which it is difficult to exclude impurities. These have been acted upon by sea-water, which obtains access to the wire, and impairs its value as a conductor of electricity. This imperfection Captain Rowett hopes to remedy, by employing virgin india-rubber, to be covered with hemp ropes, and treated with a compound invented especially for the purpose. It is estimated the cable will cost £150 a mile, and that the line can be completed and opened for traffic for a sum not exceeding £500,000.

THE WIMBLEDON RIFLE COMPETITION.—On Saturday the 16th instant, a perfectly new competition at Wimbledon, though it has been successfully tried at other meetings, was the volley-firing for the sum of £50 given by the proprietors of the *Saturday Review*, and four set of electric bells given by Count De Gendre. These bells, it may be observed *en passant*, are for the purpose of communicating between the firing-point and the mantlet, to warn the marker when a shot is about to be fired, and receive instantaneously from him a signal that he is on the alert. They have been in successful operation at the Swiss targets during the meeting. Some such means of communication is very necessary with the Swiss or with cardboard targets, through which a bullet passes with so little noise that it might escape the notice of the marker. When a miss occurs the marker at once makes an appropriate signal, which satisfies the rifleman that his shot has been noticed. It is but fair, however, to say that an equally efficient and far less expensive system of telegraphy has been in operation at Captain M'Gregor's cardboard, sweepstakes targets, 200 and 500 yards, and at the "coming man" target. His plan is to have a small mirror fixed above the mantlet in such a way as to enable the marker to see what is going on at the firing point. The officer keeping the register is supplied with a sheet of cardboard, white on one side and black on the other. When a shot is about to be fired, the white side of the cardboard is turned towards the mantlet. The marker acknowledges this by a recognised signal; when the shot is fired he sees the smoke, and either marks the spot hit or indicates that it is a miss. So well has this principle answered that markers unused to the system not only make no mistakes, but in more than one instance at the "coming man" target have instantly detected a shot that ought to have been fired at the adjoining 200 yards sweepstakes targets.

TELEGRAPHS IN NEW SOUTH WALES.—The only telegraphic works at present in progress in this colony are three branch lines, which are being carried out, under an arrangement with the residents in the several districts, that the Government shall receive five per cent. on the outlay. On the line from Braidwood to Queenbeyan a distance of fifteen miles has been cleared, and holes for the posts have been sunk for a distance of thirteen miles. The posts are all erected on the line from Deniliquin to Hay, and fifteen miles of wire suspended. The line from Wellington to Dubbo has been commenced. The estimates for 1864 being at length passed, tenders will shortly be called for new lines, for which money has been voted. These consist of extensions from Mudgee to Murrurundi, and from Braidwood to Arabren, and the continuation of the line to Cooma.

THE ELECTRIC AND INTERNATIONAL DRAMATIC CLUB.—On Thursday evening, the 14th inst., the members of this very excellent club of amateurs gave a benefit performance at the Cabinet Theatre, King's-cross, in aid of Mr. James Crawley, who has been suffering for some time from a severe and painful illness. The performance commenced with the domestic drama, "The Rent Day." Mr. James Cook played the part of *Martin Heywood* with feeling, and was much and deservedly applauded. Mr. Perry, as *Old Crumbs*, executed his rôle with care and energy. Mr. Brandon made a very good *Toby Heywood*, and will improve with practice. Mr. W. Coleman is an exceedingly clever low comedian, and his representation of *Bullfrog* was characterised by rare fun and drollery—the scene in the bedroom was especially effective, and elicited rounds of applause. Mr. Garrard was well up in the character of *Silver Jack*, and acquitted himself creditably. Mr. Tripe looked and played the part of *Grantley* well. Miss Agnes Burdett, as *Rachel Heywood*, acquitted herself in first-rate style; indeed, her acting throughout the piece was that of a finished and accomplished actress. The part of *Polly Briggs* was very nicely played by Miss Pearman. The performance of "Love in Humble Life" was very creditable; the acting of Mr. F. Perry, as *Rouslaus*, and Miss Agnes Burdett, as *Christine*, calling for especial commendation. The "hit" of the evening, however, was the popular farce, entitled "A Rough Diamond." Mr. Coleman as *Cousin Joe*, and Miss Agnes Burdett, as *Margery*, kept the audience convulsed with laughter the whole of the time they occupied the stage. Messrs. Garrard and Tripe, as *Sir William Evergreen* and *Captain Blenheim* played carefully and well, as also did Mr. Tranfield, as *Lord Plato*, who gave promise of future excellence. At the conclusion of this piece Mr. Coleman and Miss Burdett were called before the curtain and received a well-deserved ovation. The proceedings throughout the evening were very gratifying. There was an absence of that ungentlemanly conduct of which we had to complain on a former occasion, and "all went merry as a marriage bell." It afforded us singular pleasure to note the presence of several of the chief officers of the Electric Telegraph Company in the boxes, and we are persuaded that their encouragement gave a zest to the performance throughout.

COXWELL'S BALLOON.—As we have published in our columns on several occasions the valuable results obtained by the means of Mr. Coxwell's balloon ascents, we insert with great pleasure the following appeal to the scientific world, to aid the intrepid aeronaut to resume his aerial researches, his balloon having been destroyed by a mob at Leicester:—The loss of Mr. Coxwell's new balloon, at Leicester, has excited in the public mind feelings of general sympathy. This magnificent balloon had just been built by Mr. Coxwell entirely at his own expense, and was designed by him to continue and extend the aerial researches so ably conducted by Mr. Glashier, on behalf of the British Association. Mr. Coxwell's friends and admirers feel that the public, as well as scientific men, have so great an interest in his being placed in a position immediately to resume his professional duties, that they have determined he shall not be left to his own unaided resources in the present emergency. With this view, a committee has been formed as under, and a banking account has been opened, entitled "The Coxwell Balloon Fund," in aid of which contributions are now invited from the public. The committee consist of James Glaisher, Esq., F.R.S., Royal Observatory, Greenwich, Chairman; H. Emerson Westcar, Esq., Royal Horse Guards; F. G. Burnaby, Royal Horse Guards; Captain Woodgate, Norwood; Lieutenant Hatton Turner, Rifle Brigade; Count Schaffgotsch, Berlin; Frederick Norris, Esq., King-street, St. James's; W. F. Ingelow, Esq., Holland-street, Kensington; Edward Atkinson, Esq., 5, Hanover-street, Regent-street; Fredk. W. Ellis, Esq., Maida-hill; J. W. Robins, Esq., Stamford-hill; S. W. Silver, Esq., Norwood-lodge, Streatham; Osborn Stock, Esq., Torrington-square; H. Thompson, Esq., Gresham-house (with power to add to their number). Bankers—The National Bank: Head Office, 13, Old Broad-street, E.C. Branches: 47, Charing-cross; 19, Gloucester-gardens, Bayswater; 112, High-street, Camden Town; 4, Arabella-row, Pimlico. All subscriptions will be duly advertised.

EXCURSION.—On the 9th instant the annual festival of the establishment at which this journal is printed and published took place. The company, after a delightful journey on the North Kent Railway to Northfleet, alighted, and after a pleasant walk through waving fields of corn and luxuriant hop-gardens, arrived at the charming and rural village of Swanscoombe, in Kent; for the selection of such a favourable place for a day of recreation and pleasure great credit is due to the indefatigable and obliging stewards of the day, Messrs. Gill & Butler. The morning was most agreeably spent in healthy and athletic exercises, such as cricketing, quoiting, running, &c.; the races were contested with much spirit—the first, of 440 yards, being won by Mr. Hill; the 100 yards race cleverly by Mr. Stocks; and the 200 yards race by Mr. Lees, after which the company—over sixty in number—sat down to a substantial repast at the Blue Anchor tavern, towards which the firm contributed most liberally. The chair was occupied by Mr. Cornell, sen., of the printing department, the vice-chairmen being Messrs. McFee, Freeman, and Bowden, representing various departments of the establishment. After the usual loyal toasts had been proposed in eloquent and appropriate terms, the chairman followed with that of "The Firm"—Messrs. Truscott, Son, & Simmons—which was received with hearty cheers and applause. "The Ladies" and "The Press" followed, the former being responded to in effective language by Mr. Beale and the latter by the editor of this journal. Several excellent songs were sung during the evening, and after spending a most interesting and agreeable day, the company returned to town at an early hour.

THE INDUSTRIAL COMPANY OF CENTRAL ITALY.—Amongst the numerous projects of the day, a company which has in view the development of the resources of Italy cannot be but favourably received. The direction of the above company appears to us to consist of gentlemen of high position in the commercial world, and the undertaking, under proper management, must prove as remunerative as similar enterprises have proved to be at home.

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TELEGRAPH SHARES.—*Thursday's Quotations.*

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100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	105 to 109	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	2 to 1 dis.	—
10	Mediterranean Extension Tel. .	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{1}{2}$ dis. to par	—

TO CORRESPONDENTS.

WILLOUGHBY SMITH.—The query addressed to us respecting the "Electro Tell-tale" will be answered.

L. S. M.—The publication you refer to is, we believe, defunct, in despite of its medico-galvanic proclivities.

A STUDENT.—The first volume is now ready, and may be had of the publishers, price 8s. bound.

SENEX.—A gentleman well known in the telegraphic world has accepted an invitation to become a candidate for representing an important borough in Parliament on the termination of the present session.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. SMITH & CO., Strand; J. ONWHYN, Catherine-street, Strand; Messrs. DAWSON & Co, Cannon-street, E.C.; Messrs. KENT & Co, Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

Quarterly, 4s. 4d. | Half-yearly, 8s. 8d. | Yearly, 17s. 4d.

TO ADVERTISERS.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

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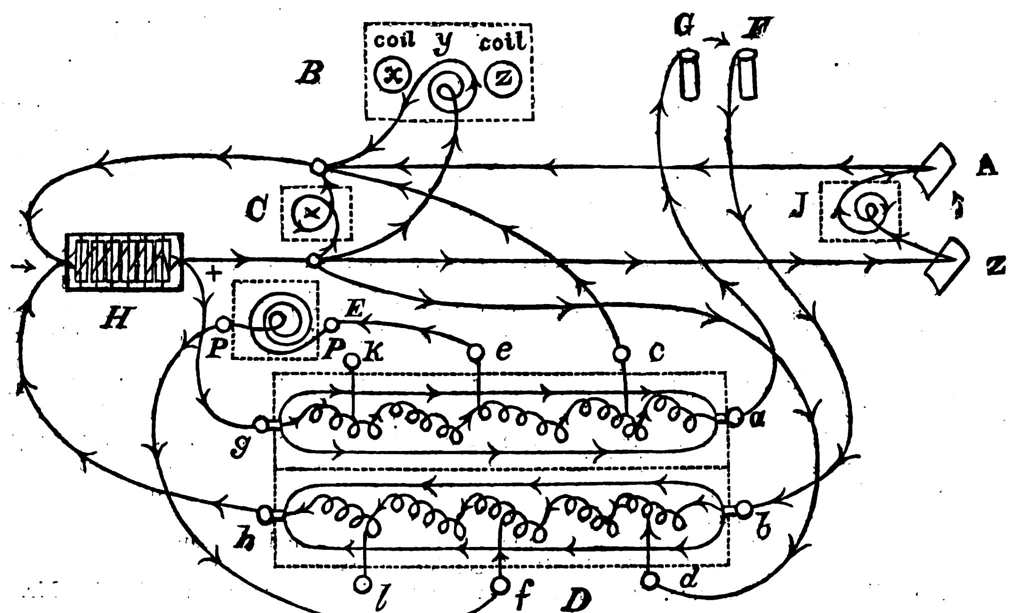
TELEGRAPHY WITHOUT CONDUCTING WIRES.

COMMUNICATED BY B. M.

I SUPPOSE, that many other persons besides myself have been anxiously looking for the publication of this patent; but till this week I have not had time to look into it. I really cannot say that Mr. Haworth's method of communicating signals is at all made patent to me, at least, and perhaps there are other dullards besides myself. When I first heard of it, I said, "Well, it is hard to say what is possible, and what is not; but at any rate this telegraphing without a distinct circuit must be by virtue of some law of electric conduction, or induction, or of both, hitherto unknown, if it is to be done at all;" for it appeared to me, that by no known law could it be done. Hitherto it has been found necessary, that half of the circuit at least must be insulated from the earth, when the earth is used as the other half: and generally, one half of any circuit must be insulated from the other half, and both from the earth, else your battery will be put on short circuit at the nearest point of non-insulation. Well, I thought, at least Mr. Haworth will show in his specification the *raison d'etre* of his system, and that will be something. I recollect, that about fifteen, or twenty years ago, we were going to have something similar done. That was really a recondite affair; but then there was a reason given for the method proposed. It was called "The Sympathetic Snail Telegraph." This was the pretended law of nature, on which it was based. That snails are wonderfully sympathetic: so much so, that if you bring snail A in contact with snail B for a short time, and then remove B, say, to the antipodes, and keep A here, if snail A's horn be tickled with a straw, B will draw in his horns at the antipodes: that is, providing he had them out; the author did not explain what would occur if he had not. Now here is the enunciation of a law of snail-sympathy at any rate, which no one can, or ought to contradict, but those who have proved that it is not so: and I am sure, I have not. After this law is settled, and fixed on a firm basis, all the rest is quite simple.

Take two boxes, each having twenty-six compartments, and in each compartment put a snail, first having marked each compartment with a letter of the alphabet, that is from A to Z in each box. Then bring snail A in one box, in contact with snail A in the other, and snail B with B, and so on to Z, and your telegraph instruments are complete. Now, if you take your box to New Zealand, and if I want to communicate with you, I take my straw in hand, and tickle my telegram out, which you will read in contortions, in your box, in New Zealand. Do you smile at the absurdity? Well, well, you will have a face as straight as a board before you have digested Mr. Haworth's system, or found the law, quasi, or other, on which it is based. I have had some hard work with it, and I mean you to have a little too; but I dare say the result will be the same with you as with me, namely, your labour for your pains. One thing I could do, and have done; that is, trace out the flow of the currents as laid down by Mr. Haworth, in his specification. This is a sketch of them, carefully taken from the abundant drawings and letter-press:—



H is the battery. C is a needle instrument, which is placed upon a box, B, in which are three coils, x, y, and z. The coils, x and z, have no connection with anything at all but the outside of the wooden reel. The coil, x, is thin ordinary insulated copper wire, coiled in the ordinary way, but apparently not for any use; the coil, z, is half filled with single insulated iron wire, and the other half with the same kind of wire, but double, and wound in an opposite direction; none of the ends have any connection with anything: it would puzzle Mr. Haworth even to tell of what use these can be. The coil, y, is connected with the other apparatus. We will go through the connections after we have described each part.

J is a box containing one coil. A is a copper plate, and Z is a zinc plate. Each plate is bent, and the convex sides are

turned in the direction in which the telegram is intended to be sent. The box, J, with its coil, and the two plates are buried in the earth. E is a box containing two coils. Each coil is wound with double wire, one wire in each coil is insulated, and the other is not. The four ends of one of the coils communicates with nothing; so I have left it out altogether, and the ends of the uninsulated wire of the other core has no connection with anything. The ends of the insulated wire are connected to the binding screws, P, P. The box, D, which the inventor calls the condenser, is divided into two compartments: each compartment contains a series of gutta-percha plates, wound round with insulated wire in one continuous length. The two series of flat coils are represented by the two series of spirals. The ends of the wires of each series are connected respectively to the binding screws, *g*, *a*, and *h*, *b*. Besides these end connections there are six others, four of them, however, only are used. The binding screws, *k*, *e*, *c*, and *l*, *f*, *d* are these connections, they are fixed in the sides of the box, and connected to the wires of the flat coils, in their passage through the box. Above and beneath these flat coils there are bands of stout gold foil, which are insulated from the coils and their four ends respectively are connected to the binding screws, *g*, *a*, and *h*, *b*, the same as the ends of the flat coils. Now in what way this represents a condenser, in any sense of the word, I have yet to find out. G and F are copper cylinders, sunk in the damp earth, and connected with binding screws, *a* and *b*, in box D.

Now for the connections. The instrument, C, is connected with the battery, H, and with the plates, A and Z, also with the ends of coil, *y*, in box, B; also with these are connected the binding screws, *c* and *d*, in box D. The ends of the coil in box J, are connected with plates A and Z; consequently with the battery, and preceding connections.

Again the battery, H, is connected with the binding screws, *g*, and *h*, in box D, and through them with the bands of gold foil, represented by the ovals in box D, and also with the flat coils in each respective compartment; these connections are continued through binding screws, *a* and *b*, in the same box, the copper cylinders, G and F. The binding screws, *p*, *p*, which are connected with the ends of the coil, in box E, are also connected with binding screws, *e* and *f*, in box D, and by their means with the internal flat coils. Binding screws, *k* and *l*, in box D have no external connection.

The inventor has not stated in what directions the currents flow; therefore we must be guided by what we find in the drawings and letterpress. The only thing we can find to guide us is the pair of buried plates, A and Z. These being a voltaic pair, the currents between them will flow from Z to A, through the damp earth. We will take this as indicating the general direction; but the circuits will be just the same whichever way we take the current as flowing. We will begin at the battery, at which there are two complete circuits, and these develope themselves into eight when the current is sent through C, and into six permanent ones when it is not. We will take the one through the instrument first, when the current is being sent through it. Then we shall have four complete circuits from this point—namely, through the instrument, through coil *y*, through the coil in J, and through the damp earth between the plates Z and A; the quantity flowing through each circuit, of course, depends on the balance of resistance. Commencing again at the battery, we have two complete permanent circuits, namely, through the coil in E, and through the damp earth between G and F; the two poles of the battery being permanently put to earth in the cylinders, G and F.

Besides these, there are two other complete circuits by means of the connection of the two systems. The ends of coil C, and coil *y*, are connected with binding screws, *c* and *d*, in box D, and by that means, when the current is on at C, there are two complete circuits with the battery, as will be seen by tracing the arrows. These make just eight complete circuits when the key is down at C. Then besides the two permanent circuits already referred to, there are four more, making six permanent circuits when the key is not down; namely, through the coil in E, and through G, F, also from binding screws, *c* and *d*, through instrument coil C, through coil *y*, through coil in J, and through Z A, making six permanent currents when the instrument is not in use. Now all these circuits are within the office, or within a few feet of it, and besides both poles of the battery are permanently put to earth in cylinders, G and F, only passing through a few feet of wire and a few inches of gold foil. Besides, when the key is down, there are four complete metallic circuits in the office, besides the coil of the instruments, which are open to the current, and one in J, buried in the earth; also the four earths, G F and A Z; but besides this, A and Z will have a current of their own, they being a voltaic pair.

Now, what will be the result of all this? Electricians, telegraphists, dilletantés! A sending of telegrams? And where to? To the mountains in the moon, or to the dog star? Will it not rather be the exhaustion of the Smee's battery in half-an-hour? And that is all. What is the use of Mr. Haworth giving himself all the trouble to invent and describe this wonderful apparatus? Would it not have been easier for him to have chalked himself a circle, and got into it with his wand and—*presto! presto?* The thing would have been done. But is Mr. Haworth in earnest? Not if his invention consists only in what is made patent. I do not know the gentleman; but I am told that he is a worthy man, and besides, it is my own opinion that he is a bit of a wag. I fancy I can see him with his thumb on his nose—of course not literally, but figuratively; no *gentleman* takes a sight physically; it is only the coster's who do that.

I have a theory about it, which makes it all clear; namely, that this gentleman is a partizan in the patent dispute, and after having sought out all the absurd patents he could find, he has thought to out-do them all, and so bring patents into utter ridicule and contempt. Still my theory may not be the right one after all; no man is infallible, and I least of all. For this gentleman says he has done it. He tells us what coils are effective to send a signal upwards of 400 miles. But how can these coils send a signal? They are not induction coils, but simply lengths of wire put on wood, and forming a complete metallic circuit, or circuits to the battery, in and about the office. They do not even terminate in the copper and zinc plates from which, he says, the signals take their departure; they merely touch them in their course, on their way through the box J: nevertheless, he has done it! There is no gainsaying that. But how? There is the rub. The specification of the patent does not make it clear, but rather makes confusion more confounded. The use of nothing is explained, the reason for nothing given; but certain instruments are described, and the connections laid down in the drawings and described in the letterpress, and we are told that this will do it; nay, that the thing has been done by it. I will not say that it must be by some new law, but that it is in direct contradiction to old laws already known these thirty years. But what can be said to the bare proposition that a current of electricity can be sent and returned at one and the same time through one and the same conductor, over 400 miles, aye, or even over a [illegible]? For really this is the question, this is what Mr. Haworth [illegible] to do, which he says he has done. He starts his curren[t] [illegible] one plate on its course of 400 miles, and receives it on its re[t]... on another plate, only a few feet away from the first, and gravely tells us this without even winking; when every[one] knows, who knows anything about the matter, that the cur[rent] will simply pass from plate to plate, taking the shortest co[urse] possible. All the absurd and contradictory apparatus descr[ibed] will be of no assistance, but the reverse; for they form [com]plete metallic circuits, which will each take its proportio[n]

the current according to its resistance, consequently the proportion of the electricity which will pass between the plates will be but small, and that will take the nearest course: so saith experience, else why so much trouble and expense to insulate line wires and cables? But Mr. Haworth says, nay. I wonder what Faraday, Joule, and all other electricians and telegraphists have been doing all their lives! Have they been babbling vain things that experience will not support, or talking common sense? How is it? I am bewildered, for Mr. Haworth has actually done it!

MALTA AND ALEXANDRIA TELEGRAPH.

No greater proof of the remunerative character of submarine telegraphy can be adduced than is to be found in the records of the Malta and Alexandria Telegraph. The statistics recently published by command of the House of Commons furnish us with material for comment, and show the rapid progress made, and the profitable business done, since the means of communication with Egypt and India have been available to the public. This line was laid by Messrs. Glass, Elliot, & Co., in the summer of 1861, but was not opened for traffic until the month of November in the same year. The government dispatches during the last two months of that year did not exceed 27; the number of local messages, 1,299; and the through telegrams, 1,615; yielding a revenue of £3,142 15s. In 1862 the traffic increased in a very remarkable degree. The total number of messages sent and received being 19,797, producing no less a sum than £38,380 7s.; or an average of nearly £2 per telegram. An account of the line and its working for 1863 is before us, and, certainly, its commercial success is very evident. The number of government dispatches has decreased on the previous year's working by 55; but the local and through messages have increased 50 per cent., yielding a proportionately augmented revenue. A few particulars concerning the construction of the cable may not prove uninteresting to our readers. The telegraph consists of a single conductor of No. 8 gauge, served with gutta-percha and Chatterton's compound, and encased in a sheathing of eighteen No. 11 iron wires. The cable is 1,535 statute miles in length, has a weight of 1.85 tons per statute mile, and is submerged in a maximum of 420 fathoms of water. Early in the present year an interruption occurred in the working of the line, owing to a ship's anchor having dragged and injured the cable. The damage was speedily made good and business resumed. On the formation of the Telegraph Construction and Maintenance Company, the lease of this line (held from government by Messrs. Glass, Elliot, & Co.) was transferred, and is likely to prove a very profitable acquisition to the Company, as the traffic this year to the present date exceeds the business of last year, by a considerable amount.

SAFETY FOR RAILWAY TRAVELLERS.

[FROM A CORRESPONDENT.]

Now that attention is directed to this subject with more than usual force, we have thought it advisable to make some suggestions that may lead to the economy of life and property, and the increase of railway dividends. Many accidents arise from passengers getting out of trains before they are properly and finally stationary. On arrival at its destination, a train is brought to gradually; but, as must be apparent to the thoughtful, the carriages being only connected by coupling chains, and kept apart by springs called "buffers," the hinder carriages must press in all their buffers, and so shorten the length of the entire train, before the weight of their impact can be overcome. It is between this period of the first pressing in of the separating springs and their after-expansion that the accidents prefer to occur. Standing with door in hand, the impatient traveller only waits till the train is nearly stationary, and then jumps out; but it may be that at that moment the "buffers" regain their power, expand themselves, lengthen the train, move the carriages, and send one or more of the feeble descending passengers under the wheels—to torture and to death.

We propose as a remedy a very simple arrangement. Under the door of each carriage let a pendulum be hung, with a small portion of it, terminated by a crown-shaped head-piece, projecting above the point of suspension. On this head-piece let there depend freely a projecting iron lip, passing under the carriage door, and being hinged inside the carriage, with a projection on its upper surface outside the carriage which will only allow the door to pass over it, and so to be thrown open, when the lip is depressed to its fullest extent. Immediately the train moves, the pendulums under each carriage oscillate, the amount of oscillation depending on the speed of travelling and the elevation of the pendulum weight. The head-piece to the pendulum top is so shaped as that the oscillating pendulum, in its deviations from the central line, raises the lip more and more, the lowest point of depression of the lip being when the pendulum is in the central line, or stationary. Then a sudden depression in the head-piece causes the lip to fall so low, that the door (supposing the lip to be held stationary in that position) would be able to pass over it. But the speed, number, and violence of the oscillations are too rapid for such a chance, and so the door is kept fastened till the pendulum ceases to oscillate. All danger will then be at end, because the few seconds needed to quiet the oscillations after the stoppage of the train will be amply sufficient to allow of the expansion of the buffers after the first impact of the carriages.

This is a cheap and simple arrangement. The pendulums could be easily added to any carriage without alteration of rolling stock, and locks would be thereby rendered unnecessary. Let the pendulums be placed on both sides of the carriages. It would be also easy to place them under the control of the "guard," and to affix close to them alarm bells, against which the pendulums should be made to strike at pleasure by mechanism or electricity. The oscillations might also be utilized most admirably for the keeping up of a telegraphic communication between each carriage of a train (if necessary) and the guard; and also to inform the passengers in each carriage of the name of the place arrived at, where and which of the carriages change passengers, the duration of stoppage, and the need for official assistance in any particular carriage.

Telegraphic communication in this great metropolis is in a backward condition, considering our requirements. Telegraphy of this kind might be introduced everywhere—in private house and business establishment—as a substitute for, and an aid to, letter-writing; but there is a want of connection, adhesion, and completeness, in the commercial appliances, and a need of public attention, somewhat unsatisfactory. Electricity, it has been proved, will increase the growth of our cereals—will retard the decomposing influences of disease, in many cases giving vitality and health—will, in fact, do anything which its thermal, sanative, and chemical character can accomplish. Let us for a few moments suppose ourselves tyros in the art. We can produce electricity by the contact of metals and liquids; can intensify the onward force of its created current by multiplication of the plate series; can multiply its volume by enlarging the surface of contact. All other arrangements are as but simple mechanism. Completing and interrupting the electric circuit will give us the initial power requisite to enable us to speak with lightning, on the wings of the wind. But like other inventions—though there are many ways in which to get up, continue, and intensify electrical forces—some are too expensive to make them commercially adoptable. Therefore, it is necessary to do as our gas companies—to give off such products in the manufacture as shall on their sale return the original outlay.

Along our highways the electric cords should be far more frequently used to give notice of fire, crime, storms, and of ordinary business concerns. Our postal system is yet imperfect. With the aid of electric telegraphy, and of pneumatic tubes, our letters might be despatched and delivered in a much shorter time, and with less fear of loss.

INTRODUCTION OF THE ELECTRIC TELEGRAPH.—How well I remember the ignorant wonder with which, travelling from Windsor to London by the Great Western, I looked upon the erection of tall posts at regular intervals along the line, and, in answer to the enquiry of a foreigner as to their use, told him I thought they were intended for gas lamps to light the railway. These mysterious standards were for the application of Mr. Cooke's patent for insulating the wires, which had been previously placed in iron tubes, buried beneath the ground.—*Charles Knight's Autobiography.*

REPORT OF THE LONDON DISTRICT TELEGRAPH COMPANY, LIMITED.

THE directors have much satisfaction in submitting to the shareholders the accompanying statement of accounts, showing that the income has now very nearly equalled the expenditure.

It may on the present occasion be satisfactory to recapitulate the half-yearly progress of the Company:—

Half-year ending.	No. of Messages.	Receipts for Messages. £ s. d.	Expenditure. £ s. d.	Deficiency. £ s. d.
June, 1860	26,115	550 19 11	2,282 10 7	1,326 2 4
December, 1860	47,365	1,058 19 2	3,294 0 6	2,168 1 7
June, 1861	64,785	2,137 1 7	4,394 12 3	2,177 11 4
December, 1861	77,939	2,592 15 10	4,663 5 4	1,995 13 7
June, 1862	123,280	3,956 4 8	5,077 17 11	1,077 15 4
December, 1862	124,222	3,999 3 2	4,958 4 2	894 0 4
June, 1863	129,710	4,216 6 11	4,721 1 3	440 9 4
December 1863	131,216	4,326 4 0	5,125 9 4	796 15 4
June, 1864	152,795	4,802 10 0	4,863 17 10	60 12 0

It will thus be seen that the increase in the income has been continuous and steady, whilst the expenditure appears to follow a fair average amount, and, it may be added, that the present rate has been found sufficient for transacting a remunerative amount of business.

From Parliamentary returns, recently issued, it appears that this Company shows the largest rate of increase in traffic of any of the existing telegraph companies.

During the past half-year the principal outlay on account of capital has been incurred in providing additional private telegraphs on remunerative terms, and in respect of the stations on the Metropolitan Railway, which were opened about the middle of the half-year, and which are worked by this Company, under an agreement with the railway company.

The general expenditure remains about the same. Under the charge for repairs and maintenance is included the renewal of the whole of the overhouse wires on the south side of the Thames, which were the first erected; and for renewing a portion of the wires in the south-west district.

The property continues in efficient working order, and by gradual repairs, as they become necessary, it is hoped that the present average expenditure in this respect will not be greatly exceeded.

BALANCE-SHEET OF THE COMPANY FOR THE HALF-YEAR ENDING 30TH JUNE, 1864.

SHARE ACCOUNT.

Dr.	£ s. d.	Cr.	£ s. d.
To capital authorised, viz.:— 12,000 shares, at £5 each	60,000 0 0	By capital called	53,700 0 0
		„ shares unissued, 1,260 at £5	6,300 0 0
	£60,000 0 0		£60,000 0 0

BALANCE SHEET.

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To capital called	53,700 0 0		By construction of works, office fittings, &c., namely:—		
„ less shares forfeited	3,450 0 0		Amount expended to 31st December, 1863	£36,993 5 1	
	50,250 0 0		„ subsequent expenditure	341 17 7	
„ less calls unpaid	59 15 0				37,335 2 8
		50,190 5 0	„ instruments, batteries, stores, tools, furniture, &c.		3,938 8 4
„ sundry creditors		3,765 12 7	„ shares held in trust for Company		672 0 0
			„ sundry debtors		1,736 4 1
			„ cash at bank and in office		700 18 11
			„ balance of profit and loss account, as per account 31st Dec. last	£9,512 11 7	
			„ balance of profit and loss to this date	60 12 0	
					9,573 3 7
		£53,955 17 7			£53,955 17 7

PROFIT AND LOSS ACCOUNT.

Dr.	£ s. d.	£ s. d.	Cr.	£ s. d.	£ s. d.
To rent, rates, and taxes	£1,607 1 10		By revenue from messages, rent of private wires, &c.	£8,004 1 0	
„ less rents of premises sub-let	698 15 0		„ less other companies' charges	3,202 0 2	
		908 6 10			4,802 0 10
„ gas		97 15 9	„ transfer fees		1 5 0
„ direction		125 0 0	„ balance		60 12 0
„ audit		7 17 6			
„ salaries		436 5 0			
„ wages, &c.		2,158 7 3			
„ repairs and maintenance		590 6 9			
„ stationery and printing		272 13 10			
„ postages		30 6 6			
„ sundry charges, travelling expenses, &c.		297 8 5			
		£4,863 17 10			£4,863 17 10

We have examined the foregoing statements with the vouchers and the Company's books, and find the same correct.

19th July, 1864.

EDWD. SANDELL, ALFRED EAMES, } AUDITORS.

REPORT OF THE DIRECTORS OF THE MEDITERRANEAN EXTENSION TELEGRAPH COMPANY, LIMITED.

IT will be seen from the balance-sheet for the past half-year that the affairs of the Company are still prospering.

The aggregate revenue has slightly decreased as compared with the previous half-year, but this is owing to the second interruption which occurred on the Malta and Alexandria line; but as that line has now been restored through the exertions of the lessees, it may reasonably be expected that the traffic will steadily augment.

Respecting the increase which will be observed in the expenditure, the directors beg to explain that it is principally owing to the establishment of an English staff of clerks at Modica, in Sicily, for the improvement of the system of transmission of telegrams through Italy, inasmuch as serious delays and mutilation of messages were of daily occurrence, which rendered it imperative on the directors to adopt some means of removing that grievance.

The Company's cables continue in the same excellent condition.

The directors recommend the usual dividend—8 per cent. per annum—on the preference shares, and 4s. per share—equal to 4 per cent. per annum—on the original capital.

They also recommend the usual 10 per cent. on the gross earnings to be carried to the reserve fund.

158, Gresham House,
22nd July, 1864.

HENRY MOOR, Chairman.
HENRY C. ORTON, Secretary.

BALANCE-SHEET OF THE COMPANY FOR THE HALF-YEAR TO THE 30TH JUNE, 1864.

Dr.	£ s. d.	Cr. ASSETS.	£ s. d.
Balance of capital account (as shown below)	302 6 11	Funded property, amount of reserve fund invested in India Five per Cents.	1,104 17 4
Amount to the credit of reserve fund	1,866 0 8	Amount due from other lines on account of messages transmitted by this Company to 30th June, 1864	18,342 [illegible] 4
LIABILITIES.		Sundry amounts due to the Company for messages transmitted	121 19 7
Deposits on account of messages to be transmitted	199 1 0	Cash at Bankers	702 7 5
Amount due on account of messages transmitted over other lines, to 30th June, 1864	12,364 2 10	Cash in hands of officers of the Company	473 8 2
Amount due to bankers in respect of loan of £3 300	800 0 0		
Sundry other amounts owing by the Company	362 17 8		
Surplus balance of dividend account	4,911 11 9		
	£20,745 0 10		£20,745 0 10

CAPITAL ACCOUNT.

Original Line.

	£ s. d.		£ s. d.
Cost of construction and preliminary expenses	117,984 19 5	Amount received for issue of 12,000 shares of £10 per share	120,000 0 0
Unexpended balance transferred to the capital account of the Corfu and Otranto line	2,503 19 1	Forfeited deposits and interest on investments	488 18 6
	£120,488 18 6		£120,488 18 6

Malta and Sicily Line.

	£	s.	d.		£	s.	d.
Preliminary expenses	397	14	0	Amount received for issue of 1,500 preference shares at £10 per share	15,000	0	0
Amount of contract for cable	12,100	0	0				
Unexpended balance transferred to the capital account of the Corfu and Otranto line	2,502	6	0				
	£15,000	0	0		£15,000	0	0

Corfu and Otranto Line.

	£	s.	d.		£	s.	d.	£	s.	d.
Preliminary expenses	252	5	10	Unexpended balance of the capital account of the original line ..	2,503	19	1			
Amount expended on construction of the land line..	521	12	4	Ditto of the Malta and Sicily line	2,502	6	0			
Amount of contract for the submarine cable	20,930	0	0					5,006	5	1
Balance	302	6	11	Amount received for issue of 1,700 preference shares at £10 per share				17,000	0	0
	£22,006	5	1					£22,006	5	1

DIVIDEND ACCOUNT.

	£	s.	d.	£	s.	d.		£	s.	d.
Amount carried to reserve fund, being 10 per cent. on the gross earnings for the half-year ending 31st December, 1863				700	3	4	Surplus balance 31st December, 1863, as per last balance-sheet	5,009	0	9
Amount of dividend on preference and original shares paid and brought to account in the half-year to 30th June, 1864				3,642	13	4	Balance of revenue account to 30th June, 1864	4,352	14	4
Income-tax on dividends ..				107	6	8				
Surplus balance after payment of above dividends........	£558	17	5							
Net profits during half-year ending 30th June, 1864 ..	4,352	14	4							
				4,911	11	9				
				£9,361	15	1		£9,361	15	1

REVENUE ACCOUNT.

	£	s.	d.	£	s.	d.		£	s.	d.
Expenses of the offices and stations in London, Malta, Corfu, Naples, Modica, and Turin, including directors' fees, viz.:—							Receipts for messages in the half-year to 30th June, 1864	6,731	7	9
Salaries, wages, and agencies..	1,587	9	0							
Rent, fuel, and light	206	5	5							
Miscellaneous and petty expenses	558	2	11							
Maintenance of the lines	81	8	11							
	£2,433	6	3							
Deduct Alexandrian lessees' proportion of Malta office expenses to 30th June, 1864	54	12	10							
				2,378	13	5				
Balance available for dividends				4,352	14	4				
				£6,731	7	9		£6,731	7	9

Audited and found correct,

W. E. ALLWRIGHT.

DETAILED STATEMENT OF THE COMPANY'S EXPENDITURE AT ITS OFFICES AND STATIONS FOR THE HALF-YEAR ENDING ON THE 30TH JUNE, 1864.

London.

	£	s.	d.	£	s.	d.
Directors' fees, salary of secretary, &c.	510	14	2			
Rent of offices	60	5	0			
Interest on loan, £2,200 (Hankey)	55	5	4			
Stationery	23	9	2			
Advertising	8	14	3			
Service messages	19	10	2			
Miscellaneous petty expenses	37	3	7			
				738	1	8

Malta.

	£	s.	d.	£.	s.	d.
Salary of superintendent and wages	548	17	9			
Rent of offices, &c.	102	1	10			
Stationery and printing tariffs	101	9	2			
Postage	40	0	0			
Furniture and fitting-up offices	48	17	9			
Maintenance of line, materials, &c.	57	9	6			
Allowance to Glass, Elliot, & Co.	28	19	4			
Compensation for damage to late offices..................	20	0	0			
Miscellaneous petty expenses	34	9	3			
				982	4	7

Corfu.

	£	s.	d.	£	s.	d.
Salary of manager and wages	238	16	10			
Rent of offices	40	11	5			
Travelling expenses, &c.	30	0	0			
Furniture	2	5	0			
Materials for repair of line, &c.	21	0	11			
Postages	10	0	0			
Stationery and printing tariffs	52	0	0			
Miscellaneous petty expenses	19	2	8			
				413	16	10

Modica.

	£	s.	d.	£	s.	d.
Salaries, &c.	159	6	8			
Travelling expenses	30	0	0			
Fuel, gas, &c.	4	9	2			
Materials, &c., for repair of line	23	10	3			
Furniture	10	18	3			
Miscellaneous expenses	18	0	10			
				246	5	2

Naples.

	£	s.	d.	£	s.	d.
Salaries, &c.	26	0	0			
Postages	0	7	0			
				26	7	0

Turin.

	£	s.	d.	£	s.	d.
Salary	25	0	0			
Postages, &c.	1	11	0			
				26	11	0
				£2,433	6	3

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.*

I.

THE indexes to patents are now so numerous and costly as to be placed beyond the reach of a large number of inventors and others, to whom they have become indispensable.

To obviate this difficulty, short abstracts or abridgments of the specification of patents under each head of invention have been prepared for publication separately, and so arranged as to form at once a chronological, subject-matter, reference, and alphabetical index to the class to which they relate.

The following rules have been adopted in deciding which specifications belong to this series of inventions.

1st. To include all specifications in which mention is made of electric or magnetic force as applicable in carrying out the invention.

2nd. To include all which depend on electric or magnetic science, whether such dependence is mentioned or not.

3rd. To exclude those in which no mention is made of their application to electric or magnetic purposes, although it may be somewhat evident that such application might be made. For instance, as in some specifications, no mention is distinctly and directly made of the application of gutta-percha to the coating or covering of wire for electrical purposes, it is not included in this series, although such an application of the invention is evident.

4th. To exclude all those in which no other allusion to electric or magnetic science is made than the word "galvanized," as applied in the ordinary process of zincing iron.

In all cases in which a reasonable doubt exists as to whether an invention is to be included in this series or not, the abridgment is included, and the cause of doubt stated.

In making the abridgments of specifications of mechanical applications of electricity and magnetism, the rule of tracing their operation from the prime mover to the result has been observed, when possible. A similar rule has been observed with reference to electro-chemical processes. The course of the electric current from one battery pole to the other, through the work to be done, has been traced in all cases in which such a method of treating the subject could tend to clearness of description. When the complicated nature of the subject requires it, each description is begun by a short summary of the whole action of the machine or process treated of.

* Printed by order of the Commissioners of Patents.

All the quotations from the printed specifications (included between quotation commas throughout the work) are given in the exact punctuation and orthography therein used; however, to draw attention to any passage more immediately connected with this series of abridgments, portions are sometimes italicised that appear in Roman type in the original.

Care has been taken to preserve correctness in the use of the scientific terms occurring in the work, a caution rendered necessary by the frequent misappropriation of terms by inventors. The word spiral, for instance, is frequently used instead of helix, isolate for insulate, aluminium (the French name) for aluminum, &c. &c. To avoid misunderstanding in regard to the meaning of terms which some patentees appear to consider synonymous or doubtful, the following definitions are given:—

Brake, an apparatus used to stop rotation, or other mechanical movement, by the friction of surfaces. (See *Practical Mechanic and Engineers' Magazine*, October, 1843, pp. 25-27, December, 1843, pp. 98, 99, and April, 1844, pp. 258, 259.)

Break, a commutator, or apparatus to interrupt or change the direction of electric currents. (See *De la Rive's Treatise on Electricity*. Vol. I., p. 377.)

Helix, a screw-form curve. A curve generated by winding an inclined plane round a right cylinder; this curve is necessarily not situated in one plane, as all its points lie on the surface of a cylinder, and therefore at equal perpendicular distances from the cylinder's axis, the said perpendicular uniformly increasing in height above the base of the cylinder. According to another definition, it is the curve formed by a straight line twisted round a cylinder, so that the perpendicular distance between each convolution is a constant quantity. It may also be defined as "the curve of double curvature formed by a thread, wrapped round the surface of the cylinder, so as always to make the same angle with the axis." This term is used to name the curve formed by the winding of the external protective wire round electric telegraph cables; it also applies to electro-dynamic coils, to springs that act by tension in the direction of their axes, and to other similar arrangements. (See *Encyclopædia Metropolitana*, Integral Calculus, Part III., pp. 143, 144; also *Library of Useful Knowledge*, Differential and Integral Calculus, pp. 396 and 415-417.)

Insulate, to separate, electrically speaking, or to surround with a non-conducting body; this term is used in reference to an electrified body which it is desired to preserve in that state. (See *Dr. Golding Bird's Natural Philosophy*, p. 162.)

Isolate, to separate or detach; this word has no express meaning in the electrical vocabulary. (See *Maunder's Treasury of Knowledge*, Dictionary in Part I.)

Pall, a click that falls by its own weight into the teeth of a toothed or ratchet wheel. (See *Practical Mechanic and Engineers' Magazine*, April, 1844, p. 251.)

Spiral, a curved line situated in one plane, and generated as follows:—A straight line of indefinite length moves round a fixed point and from a fixed line passing through the point; a point also moves along the moving line, starting from the centre or fixed point at the same time that the line commences its motion; the point will trace out a curve commencing from the centre and extending through a series of turnings gradually outwards, which curve is a spiral. It may also be defined as the curve formed by twisting a straight line round a fixed point, so that the distance between each convolution, radially, is a constant quantity. Mathematicians recognize several distinct kinds of spirals, each having its own characteristic properties. This term is used to name the springs that are in one plane, and act by unwinding a barrel, such as the main spring of clocks and watches, &c.; it is also applicable to flat electro-dynamic coils commenced upon a core and proceeding outwards by convolutions in one plane. (See *Library of Useful Knowledge*, Algebraical Geometry, pp. 193-195, Differential and Integral Calculus, pp. 356-358, and Practical Geometry, pp. 118, 119; also *Hind's Differential Calculus*, pp. 262-285; also *Encyclopædia Metropolitana*, Integral Calculus, Part III., pp. 136, 137.)

Berzelius' ammonium theory has been adhered to throughout the text of the work, and the best recognised names for chemical and metallic bodies, such as platin*um*, alumin*um*, ammoni*um*, have been adopted.

When two words are used as one adjective to qualify a noun, they are connected by a hyphen thus—"line-wire circuit," in contradistinction to "local circuit," &c.

In an appendix will be found the abridgments of eleven specifications omitted from the body of the work, but which are duly recorded in the indexes.

In the title and introductory part of these abridgments the word "generation" is employed as the equivalent of the various expressions, "producing," "exciting," "inducing," or "developing."

Under the word "electricity" is included statical, frictional, or tension electricity, steam electricity (or hydro-electricity), galvanic (or voltaic) electricity, thermo-electricity, magneto-electricity, that induced in electro-dynamic coils by secondary currents, or by their movement across the lines of magnetic force, that evolved from heated substances as tourmaline, talc, &c. (pyro-electricity), and from electric fish, as the torpedo, gymnotus electricus, &c., animal electricity, and other sources of less note.

Under the word "magnetism," that of permanent, induced, or electro-magnets, under whatever form they may be set forth, is included.

It is hoped that the publication of these abridgments will prevent the disappointment consequent on repatenting an old invention, and, by setting forth what has been already done in this department of practical science, enable inventors to exert their talents upon discoveries and applications at once new and practical.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE Thirty-fourth Meeting of the British Association for the Advancement of Science will commence at Bath, on Wednesday, the 14th of September, 1864, under the Presidency of Sir Charles Lyell, M.A., LL.D., D.C.L., F.R.S., and the following are the arrangements for the meeting:—

The General Committee will meet on Wednesday, the 14th of September, at 1 p.m., for the election of sectional officers, and the despatch of business usually brought before that body. On this occasion there will be presented the report of the Council, embodying their proceedings during the past year. The General Committee will meet afterwards by adjournment. The first general meeting will be held on Wednesday, the 14th of September, at 8 p.m., when the President will deliver an address; the concluding meeting on Wednesday, the 21st of September, at 3 p.m., when the Association will be adjourned to its next place of meeting. At two evening meetings, which will take place at 8 p.m., discourses on certain branches of science will be delivered. There will also be other evening meetings, at which opportunity will be afforded for general conversation among the members. The Committees of Sections will meet daily, from Thursday, the 15th of September, to Wednesday, the 21st of September, inclusive, at 10 a.m. precisely. The Sections will meet daily, from Thursday, the 15th of September, to Tuesday, the 20th of September, inclusive, at 11 a.m. precisely. Reports on the progress of science, and of researches entrusted to individuals and committees, and other communications intended for presentation to the Sections, are expected to be forwarded in letters addressed to the Assistant-General Secretary, at Bath, previously to the meeting, accompanied by a statement whether the author will be present, and on what day, so that the business of the Sections may be satisfactorily arranged. The reports complete, and concise abstracts of other communications, are to be delivered to the Secretaries of the Sections before which they are read, previously to the close of the meeting, for publication in the Transaction. As the reports on Science may be interesting to more Sections than the one which originally called for them, it is desirable that the authors should be prepared to furnish the means of reading them in any other Section at the request of the President and Secretaries of that Section. The following are the titles of the Sections to which communications may be presented:—Section A. Mathematics and Physics. B. Chemistry and Mineralogy, including their applications to Agriculture and the Arts. C. Geology. D. Zoology and Botany, including Physiology. Sub-Sections D. E. Geography and Ethnology. F. Economic Science and Statistics. G. Mechanical Science.

At the first meeting of the General Committee it will be proposed by Dr. Hunt, "That Section E. shall include Geography, Ethnology, and Anthropology." An Index to the volumes of Reports of the British Association, from 1831 to 1861, is printed, and will be issued to those members who have subscribed for it, at 12*s*., carriage included.

TORPEDOES.—A correspondent of the *Scientific American* describes the manner in which the Confederates have introduced torpedoes to their enemy's vessels. It appears that a small screw propeller is employed to bear a message, under a flag of truce. At the head of this tug (a seemingly harmless vessel, being no more than twenty-five feet long), under water, is attached by ropes a torpedo. It is made of half-inch boiler iron, 33 inches outside diameter; length, 4 feet; cylindrical length, 22 inches; and contains 1,015 lbs. powder. This instrument is furnished with spikes and is connected with a galvanic battery by insulated wires. "In the affair of the attack on the Minnesota, after replying to the hail, the tug stopped a moment, then suddenly steamed under full headway, bow on, for the Minnesota, thrusting the torpedo forcibly against the ship, thereby causing the spikes to fasten themselves firmly in the timbers; then, on cutting the ropes, the tug was instantly detached from the torpedo, and backed rapidly to a safe distance, and the powder fired by means of the wire of a galvanic battery."

ARRANGEMENTS FOR METEOROLOGIC TELEGRAPHY.

IN a previous number of this journal we published an abstract of the report of the meteorologic office of the Board of Trade for 1864. This department was originated in 1854-5, and since that date a mass of valuable records has been obtained, classified, and published, under the direction of Admiral FitzRoy, to which we desire to direct attention. Before the establishment of the meteorologic office the data of meteorology were scattered, and in a state unavailable for observation and comparison—so essential in the reduction of phenomena to principles and uses. These have been brought to order, and a science has been evolved the importance of which to the mercantile marine can hardly be estimated. Professor Dové says, "The problems of the atmosphere are too complicated to allow of their solution off hand," yet within the brief space of ten years a system has been instituted whereby meteorological variations, &c., are communicated to, and received from, nearly all the coasting stations of the United Kingdom and the Continent. One result of these arrangements has been an immense saving of human life and valuable property. In order to extend the usefulness of this department application was recently made to the House of Commons for an increase of the annual grant allowed by the Treasury for meteorologic purposes. Exception was taken to the vote, but we are glad to find that the intelligence of the House of Commons prevailed over the peurile objections urged against the labours of Admiral FitzRoy, and that a grant of £7,900 was voted by a large majority. In the report above referred to the author says: "I submit that our knowledge of atmospheric changes and their indications is already sufficient for practical purposes, and may be communicated to a fairly educated person." We can, therefore, attribute the opposition to but one reason, which will be sufficiently obvious.

The following directions have been furnished to the various seaports and elsewhere, which will show the exactitude required, and care bestowed in making observations, and in the arrangements for meteorologic telegraphy; and will also enable many of our readers to understand the arbitrary signs (rendered necessary by limited space) in the daily weather bulletins emanating from the meteorologic office of the Board of Trade :—

Two barometers should be suspended indoors, so that one may be a check on the other. The distinguishing number of whichever is used, and its estimated height above high water, should be made known, by telegraph, the first day; and occasionally afterwards, when requisite. Knowing here your tidal peculiarities—elevation above mean sea level is obtained.

Two thermometers should be fixed outside the house, at the north side, and a third near them, with its bulb wet, or, rather, moistened.

Once a day, at about eight in the morning, the rainfall (R), the highest or lowest extreme of the mercury in the barometer, and in the exposed thermometer (T), since last report (as nearly as can be ascertained by the reporter), the reading of one barometer (B), and its attached thermometer—the character of the weather since the last report; the reading of the exposed dry thermometer, the difference always less—of the moistened thermometer; the direction of the wind at that time (W), its estimated force (F), the character of the weather at that time (I), and the state of the sea (S—sea-disturbance); should be telegraphed to the meteorologic office, in accordance wth the following explanations.

Each telegram will usually consist of five or six groups of figures (each group containing five figures), and perhaps a few words or letters.

No alterations or reductions are to be made by the observer, who will transmit them as "read off" (except in a few special cases).

Rainfall, Snow, or Hail (if any).

The first group will be "rainfall" (R), omitting decimal points between or before figures.

With each morning report, when rain enough has fallen to be measurable, its duration, in hours, from 1 to 24 (or to 48, after Sunday or a holiday), should be in the two first places of a group, or word, of five figures; a cypher being before 1 to 9. Quantity of rain, &c., should be shown by the three last figures of five as inches and two places of decimals. Thus, if rain had prevailed about eight hours since last report, and an inch and a-half of water was in the gauge, the group should be 08150; if thirteen hours, with two inches and five hundredths, the group should be 13205; if three hours and thirteen hundredths, then 03013.

Highest or Lowest Extreme.

The second group will show the highest or lowest extreme (the most remarkable) of the mercury in barometer (B), and in exposed dry thermometer (T), since last report by telegraph, whether recent or otherwise.

B will have the three first places for last integer and two first decimals; T will have the two last figures for degrees (only) of exposed dry thermometer. Thus, supposing $B = 30.142$ and $T = 59$, the telegraphic group should be 01459; or if $B = 30.147$ and $T = 59.8$, it should be 01560 (7 and also 8 being more than one half).

Barometer (B).

The third group will be the height of the barometer (B), read to two places of decimals, but omitting first figure, and points—but adding two figures for the temperature of the attached thermometer, to degrees only; thus, 90462.

The fourth group should express the extreme, not general character of wind and weather (W, F, I) only, since the last report, or during the whole time elapsed since the last hour of reporting (as far as can be ascertained by the reporter).

The first two figures will show direction of wind (W); the third and fourth figures, force (F); and the last figure, character (I). Thus, supposing $W = 10$, $F = 6$, and $I = 7$ (rain), the telegraphic group should be 10067.

Thermometer (T) and Difference with Direction of Wind (W).

In the fifth group the first three figures will show the reading of the exposed thermometer (T) and its difference above the moistened one; and the two last figures the direction of the wind (W) given by the true meridian (by the sun or pole star, by a chart, or by the world).

The direction of the wind will always be given in figures—1 to 32—North being 32, East 8, South 16, West 24, and so, proportionally, for the intermediate points, a cypher being placed before the figure indicating the direction when less than 10, (= N. by E. to E. by S.) Thus, supposing $T = 54$, diff. $= 3$, and $W = 8$, the telegraphic word will be 54308.

Force of Wind (F).

In the sixth group the first two figures will show the estimated force of the wind (F) from 1 to 12, supposing 1 to represent the lightest breeze, and 12 a hurricane (a cypher being placed before the figure indicating force when it is less than 10).

Amount of Cloud (C).

The third figure gives the estimated amount of cloud (C) from 1 to 9.

Character of Weather—Initial (I).

The fourth figure indicates the character of the weather (I), according to the abridged "Beaufort scale."

Sea Disturbance (S).

And the fifth figure the amount of "sea disturbance" (S), from 1 to 9. Thus, supposing $F = 2$, $C = 3$, $I = 1$, and $S = 4$, the telegraphic word would be 02314.

No decimal points should be noted in the telegrams. Using the method just described, they are unnecessary: while each decimal point might be counted as a word or figure, and thus increase expense.

Five figures should be placed invariably for each word, cyphers being used to keep the figures in their proper relative places; the cypher being very carefully placed, and always before the unit, or other cypher, to which it refers, when used for this purpose.

Special occasional information, when necessary, should be transmitted in the common manner by actual words, in addition to the above described groups; but abbreviations should be made, by substituting such letters for words as are used in the scales to which reference is made in these directions.

No regular meteorologic telegram is required to be forwarded on Sundays or official holidays, but one reading of instruments, and a regular notice of the previous weather, &c., should be taken on such occasions, and recorded, with other daily ordinary observations, in a regular form, which should be sent by next post.

It will be understood that telegrams should be despatched from their starting points (if practicable) at eight o'clock in the morning, and from selected special stations at two in the afternoon. To effect this the observations should be made, and the summaries of recent weather well considered, before those hours arrive. The slight changes that may occur, in about a quarter of an hour, are of little importance compared with the real advantage to the public of early and sufficiently precise information.

Reporters should send extra telegrams, at times, on their own responsibility, when the barometer is falling much or rapidly; say, having fallen nearly one-tenth of an inch, hourly, for more than two hours, since the last weather report was sent to London.

All telegrams, from all stations, should have five or six groups of figures in the morning; but in the afternoon, from the special stations, fewer may be transmitted.

It should be clearly understood that the first and second groups of figures refer to the whole interval of time, whether only a few hours, or one or two days and nights—as from Saturday to Monday—elapsed since the last official telegram, whether a regular or an extra report.

The reports of weather just recently prevailing, and the extreme ranges between the last two transmitted records, are very valuable; and it is earnestly hoped that not only individual abilities and judgment will be exercised, but also that conclusions may be drawn from the opinions of others, especially seafaring persons, shepherds, fishermen, gardeners, or agriculturists.

When reports are delayed beyond such a time as would enable them to be published in their proper order, they should be sent by the next post: not by telegraph, as in such cases they can be used only for record, and subsequent inter-comparison.

Although reporters are not on duty beyond a certain time of the day, it is hoped that general, and occasionally special information will be obtained by them from other persons, which may much enhance the value of their communications, and will be duly estimated in future arrangements, as well as in recommendations to favourable consideration.

RAIN AND FOG.

Portable rain gauges should be placed on the ground, or in any position exposed to a free fall of rain, snow, or hail, where neither buildings, nor walls, nor trees shelter or cause eddies of wind. They should be supported by a frame, or other means, admitting of their being emptied daily, but preventing their being blown down.

Generally, on or near the ground is preferable to an artificial elevation; but, if so raised, height above ground should be registered and officially reported.

From day to day, in the morning, the quantity of water from rain, snow, or hail (melted) should be measured very carefully and recorded.

It is not expected that exact duration of rain, snow, hail, or fog can be usually registered, but very near approximations may be made by collecting the notices of various persons. When fog continues for an hour or more, its duration and character should be registered and telegraphed with the next usual morning report, thus, "Five hours of very thick fog till seven p.m.," or, "Three hours of light fog still continuing," &c.

The measuring glass or tube should be used with great care. The gauge should not be opened oftener than once a day (except on occasions of heavy rain, thick snow, or much hail, in a comparatively short time).

The glass tube (supplied in duplicate) is graduated to inches and decimals. The marks are fixed by actual trial, and comparison with another kind of rain gauge duly verified. They are artificial inches. This tube should be placed upright in the gauge, with its upper end open; then a thumb or finger pressed on the upper aperture, while the tube is lifted gently out, holding in the lower part a small quantity of water, the upper edge of which is at the mark to be read off, and registered. Smaller decimals of an inch may be estimated by eye. The rain gauge should then be completely emptied and carefully refixed.

CAUTIONARY OR STORM-WARNING SIGNALS.

A staff and two canvas shapes being provided, the following use may be made of them occasionally; perhaps once or twice in a month on a yearly average.

One shape, that of a drum, or cylinder, has the appearance of a black square of not less than three feet, seen from any point of view, when suspended.

The other shape, a cone (not less than) three feet high, appears triangular (from any point of view) when suspended.

A cone, with the point upwards, shows that a gale is probable; at first from the northward. NORTH CONE.

A cone, with the point downwards, shows that a gale is probable; at first from the southward. SOUTH CONE.

A DRUM alone shows that stormy winds may be expected from more than one quarter, successively.

A cone and drum give warning of dangerous winds, the probable first direction being shown by the position of the cone—point up, above the drum for northerly, or polar wind, W.N.W. by the north to E.S.E.; point down, and below the drum, for southerly, or tropical E.S.E. by the south, to W.N.W.

A conspicuous place should be selected for signalling, near the telegraph station, whence other places may repeat the signal, or be warned; and, if practicable, the signal staff or pole should be in view of seafaring persons, besides the nearest coast-guard station.

When both these objects cannot be attained without too great distance from the telegraph station, one only—that of visibility to some of the seafaring community—should be secured; and in this case a message should be sent to the nearest coast-guard.

Whenever such a signal is shown, in consequence of a telegram from London, it should be kept up distinctly till dusk of that day only, unless otherwise specially directed.

These cautionary signals advert to winds during some part of the next night and two or three days; therefore due vigilance should prevail until the weather is again settled, but without deferring departures or any other operations unnecessarily.

More extended notice may be given by local interests and authorities, as London can only warn principal outports. The coast-guard will repeat the warning as far as means allow, and extension of such cautionary notices can be effected by private assistance along the most frequented shores, where alone they are required.

When a cautionary telegram is received at any place after four o'clock p.m., it should be followed by a Night Signal, which should be hoisted at dusk, and kept up till about nine o'clock, or even later, till toward midnight.

NIGHT SIGNALS.

Three or four signal lanterns are intended to be hoisted, as shown in the following diagram.

They should be kept up from dusk, or the time of receiving a warning telegram, until late the same evening; even till near midnight, if thought advisable on the spot, but not after that time.

A person should be employed to clean, trim, hoist, keep alight, take care of, and return these signal lanterns, for which service payment for each night of actual use will be made. This payment is intended to be an average, whether three or four lanterns are hoisted, and for whatever time shown lighted.

Spreaders, or yards, not less than four or five feet long, should be provided at each station, with good durable rope fittings.

Larger signal shapes, and better lanterns, masts with yards, and greater distances between the lights of a signal, would be desirable—though at present too expensive for general establishment.

Telegrams will not be sent on Sundays, except on emergencies (seldom occurring), and then, of course, only to those stations open at the time; but as vigilance will always prevail, by night as well as by day, on the part of the meteorologic office, no extensive change of weather, or generally dangerous atmospheric commotion ought to be unforeseen, nor should delay occur at any time in telegraphing to the coasts threatened, since attempting to prevent unnecessary risk of human life is the important object of these measures.

It should be remembered that only the greater and more general disturbances of the atmosphere can be made known by this method, not merely local or sudden changes which are not felt at a certain distance, and do not therefore affect other localities. Local changes should be indicated to observers at such places by their own instruments—by signs of the weather—and by due attention to the published weather reports.

Much inequality of atmospheric pressure (tension), or temperature, great fall or rise of the barometer, sudden or rapid alterations, great falls of rain or snow, foretell more or less strong wind, with its usual accompaniments, either in some places only, or throughout an extensive area of hundreds, if not thousands of miles; some tracts, however, remaining almost unaffected, unless by rain or squalls.

Speaking generally, there is less occasion to give warning of southerly gales, by signals, than of northerly, because those from the southward are commonly preceded by notable signs of the atmosphere, such as a falling barometer, and a temperature higher than usual at the season; whereas, on the contrary, dangerous storms from a polar quarter—north-west to north and easterly—are sometimes sudden, and preceded by a rising barometer, which may mislead persons, especially if accompanied by a temporary lull of a day or two, with a fallacious appearance of fine weather. This fallacy is caused by a circuitous movement of wind following—influencing by checking and then overpowering, or uniting with—a preceding similar sweep.

Occasionally, however, a southerly gale begins with a high barometer, and only as it increases does the glass fall. This occurs when the mercury has fallen notably in the north, and is still falling there.

Southerly gales in the Channel, and on our south-westerly coasts, are often, if not generally accompanied by northerly or easterly winds on the east coasts of Scotland, which at times affect England also on the north-east. Between these opposite winds (which are parts of circuits) more or less space, with variable light, or squally winds, occurs; and as such areas are uncertain, according to localities and extents of circuits, they should be included in cautionary notices, although at times it may be seemingly without occasion.

When a gale occurs with a high barometer, which does not fall, but remains steady, or rises, a northerly (polar) wind, or a duration of fine weather, may be expected, and more of either as the delay of approach is greater.

These signals are intended to be cautionary, however otherwise called. Limits of space and time are not assignable to winds so accurately as to warrant exact definitions for specific places. Only general terms, and districts, or coasts, are expressed, within which margins individual judgment may be fairly called into exercise.

While giving notice of considerable atmospheric disturbance over a part, or the whole of the British Islands, these signals are not intended to interfere with local knowledge, or to be in any degree compulsory.

(To be continued.)

THE PERSIAN GULF TELEGRAPH.

(Continued from page 20.)

The ships all arrived at Gwador by the 29th of January, when they were met by the Victoria, Captain Arnot, and the Clyde (gunboat), Captain Hewitt. The Kirkham's cable had to be laid first, as she had on board the shore end, 6·37 miles in length. After a careful survey of the bay, it was found that the Kirkham could not approach within three miles of the beach. It was, therefore, determined to pay out as much from the gunboat Clyde as her draft of water would permit, and lay the rest as usual from boats. The gunboat was, therefore, prepared for this operation by the removal of her heavy gun amidships, and filled with a portion of the Marian Moore's break, called the holding back sheave, which consists of a large V sheave, having a break attached to it. The cable passes over this sheave, and is made to grip in the sheave by a small weighted pulley resting on it (termed commonly a jockey pulley). Thus, when the break is applied it checks the passage of the cable. This sheave is used on board the ships to make the cable lead tightly on to the large drum behind which it is fixed, in the same way that a man, when easing a rope round a bollard, holds on to make the

turns bite. This machine has never before been employed as a break by itself alone, and its adoption was necessitated by the long length of cable which had to be laid in five fathoms of water from a ship that was too small for the reception of the regular break. The usual plan adopted in landing shore ends is to check it by hemp hand stoppers, which are imperfect in their action, besides being quickly worn out when the distance is so great. Judging from the admirable manner in which it answered, this, or a modification of the same, will be used in laying shore ends in future.

Two miles of shore ends were coiled on the deck of the gunboat, and upwards of half a mile in each of the Zenobia's paddle-box boats. The Kirkham, Clyde, and paddle-box boats were then towed to a buoy, placed as near the shore as the Kirkham could approach, and the latter having anchored, the cable was payed out from the Clyde towards the shore, and afterwards that from the paddle-box boats. The end being landed, and the cable carefully tested by Mr. Laws, the electrician to the expedition, and his assistant, Mr. Lambert, the operation of paying out commenced at about eight p.m. of the 4th of February. All the hands in the cable ships, consisting of a number of experienced hands from England, and a number of old hands late of the Bombay marine, were told off in two watches to their various stations. These stations consisted—firstly, of the cable men in the hold to clear away the wood packing, &c.; secondly, of the ringmen on the lower deck to lower and adjust the rings, &c.; thirdly, of the men stationed from the hatchway along the bridge to the poop, to pass the word from the lower deck or hold to the poop; fourthly, of the breaksmen and their assistants, and besides these, the signalmen on the forecastle, the logmen, and lamp trimmers, and various quartermasters and messengers.

Each of these separate departments had a leading hand in charge, besides a general foreman of the whole, who reported, at the beginning of his watch, and afterwards from time to time, to the engineer on duty, as to whether each man was at his post, and all going well above and below deck. No shouting, or even loud speaking, was allowed on any account. The ship's officers had to restrain the usual tendency of sailors to make themselves heard from the poop to the foretop, and, indeed, special precautions had to be taken to prevent, during the heaving of the common log, the cry of "Stop" when the glass is run out, and which in a ship when a cable is running out at the rate of 6½ knots an hour, has rather an alarming effect in the middle of the night to those who are anxious or have delicate nerves.

All the machinery worked smoothly, and, as the cable was confined and guided by fair leaders and guides in the most perfect manner from the hold to the breaks, so as to prevent it effectually from jumping and swaying about, it ran itself overboard in the most docile manner, and in respectful silence, while, there being no ship's engines to clink and clack, another cause of noise was, in this case, eliminated, and the total absence of the usual noise in paying out a cable was really remarkable, the silence at times being such that the fall of a pin could have been heard.

Of course, as the motive power was not in the cable ship, it would have been impossible to stop so suddenly as in a steamer, where the engines can be reversed, and it was in consequence of this that every precaution was taken in designing the machinery and arrangements to prevent the possibility of requiring such a sudden stoppage, and, indeed, except to change from hold to hold, no such necessity for stopping at all during the laying of any of the separate lengths ever occurred.

It was only common prudence, however, to have at hand the means of communicating quickly from the cable ship to the towing vessel as to easing, and stopping, and going on. This was done in the daytime by three small hand flags, white meaning "go on," or "all right;" blue, "ease her;" and red, "stop her!" At night a white, green, or red light was used instead of the flags. One of these signals was constantly displayed on the forecastle of the cable ship, and a similar one on the taffrail of the Zenobia showed the signal was seen and understood.

It was further very desirable to have the means of communicating freely between the cable ship and towing ship as to the course, tides, soundings, rate, and as well as to give special instructions from the cable ship to the towing ship when the end was about to be buoyed, which occurred on two occasions during the laying of the Gwador and Kurrachee section. To have attempted to do this by the old cumbersome means of flags or lanthorns would, it was felt, have been utterly useless.

The system of representing the dots and dashes of the Morse telegraphic alphabet in the day by a rough piece of mechanism, which allowed of a white dot being shown suddenly on a black board, and kept there for any required period, and at night by means of a light enclosed in a box, with the means of eclipsing or showing it at pleasure, was, therefore, experimented on between the Marian Moore and the Semiramis when on their passage from Bombay to Gwador, and found to answer so admirably that it was thenceforth adopted as the general means of speaking from one vessel to the other throughout the whole expedition. At first it was only used between the cable and towing ships, but the naval officers soon saw the value of the system, and were enchanted with it, and each began in the most persevering way to study the Morse alphabet. As several officers succeeded in learning to "read" and "send" very creditably, it was used as a general means of communicating between the ships when at anchor, and, indeed, when the Zenobia, Assaye, Amberwitch, and Scinde were laying in Gwador Bay before laying the Gwador and Kurrachee section, lights might be seen flashing away from three of the ships at a time.

The saving of time and labour to boats and boats' crews is sufficient alone to recommend the system to general use at sea.

With regard to the navy, it would, of course, be invaluable; but true to their principles, it is not likely that that very cautious Conservative body, the Lords of the Admiralty, will adopt it until it has been at least ten years in use by the mercantile marine, Lloyds, &c.

But, although there is not much hope of its being formally introduced by the Admiralty into the royal navy, there is some chance of its being brought in a less formal manner to the notice of naval officers generally, as Commander Bradshaw, R.N. (commander of H.M.S. Severn), who accompanied the expedition as principal surveyor, has learnt to "send" perfectly, and has flashed many a joke from the Zenobia to his friends in the cable ships.

(To be continued.)

SONG OF THE ELECTRIC TELEGRAPH.

BY E. L. BLANCHARD.

Away where the sunlight is bright'ning,
Away where its last beams expire,
I speed with the flash of the lightning,
I fly on the wings of the wire!
By me are earth's barriers riven,
By me are its boundaries spread;
A word, and the impulse is given;
A touch, and the mission has sped!
Hurrah! 'tis the best conjuration
That Science, the wizard, has done!
Through me nation speaks unto nation,
Till all are united in one.

In silence I stealthily travel,
Unseen, and unread, and unheard,
For not till my agents unravel
My secret is whisper'd a word.
Through darkness and daylight, unheeding,
Alike on my errand I go,
To deep-throbbing hearts ever speeding
My tidings of gladness or woe.

What matter the theme or the distance?
All heed what my messenger brings;
To Commerce I lend my assistance,
For Cupid I quicken his wings,
Now thwarting some runaway wooing,
I cling to the fugitives' track;
And now with Law's vengeance pursuing
I bring the pale criminal back.

Ere the voice of the echo had spoken,
Ere thought could recoil from its birth,
If the links of my path were unbroken,
My flight would encompass the earth;
From the bright star that gleams far above us,
Flashed onward through measureless spaec,
A welcome from voices that love us,
My own in a second would trace.

Oh! would that some kindred communion
To man we could hope to impart,
That a bond of such magical union
Might link every heart unto heart!
Not a tear that we now seek to smother
Would then fall alone or uncared,
Not a joy, but the heart of another
Would thrill with the bliss that it shared.

We need not, should fate give denial,
This fanciful dream wholly spurn;
Let sympathy touch but the dial,
A chord shall be struck in return.
No wish need be kept unimparted,
Or lost as on selfishness thrown,
But each from the heart as it darted
Would find a response in our own.
Oh! let love take the world and prepare it,
As swift to respond as receive;
Let us hear but of sorrow to share it,
And know but the want to relieve!

BENJAMIN FRANKLIN'S LABOURS.—Mr. Parton, an American writer (and the husband of "Fanny Fern"), in his "Life and Times of Benjamin Franklin," recently published, thus refers to the labours of this eminent man in the development of electrical science. "He devoted the leisure of seven years and all the energy of his genius to the science of electricity, which gave a stronger impulse to scientific inquiry than any other of that century. He taught Göethe to experiment in electricity, and set all students to making electrical machines. He robbed thunder of its terrors and lightning of its powers to destroy."

CORRESPONDENCE.

PATENT OFFICE LIBRARY AND MUSEUM OF INVENTIONS.

To the Editor of the Telegraphic Journal.

Sir,—It may not prove uninteresting to many of your readers to know what is being done relative to the proposed erection of a new Patent-office Library and Museum of Inventions.

The thorough inadequacy and inconvenience of the Chancery-lane Patent-office, and the hopelessness of ever rendering the same efficient for the use of the inventors and the public, are now well known, the inconvenience being so great that not only is the ordinary business impeded, but the advantage which should accrue to inventors, manufacturers, and others, from being able to inspect, free of charge, the valuable collection of scientific books and specifications contained in the library, are almost nugatory. The library is nearly choked up with confusion and constantly increasing mass of books and specifications of the highest practical and scientific value, and had not the approaches in the library been brought into temporary requisition some time ago for library purposes, access to the library itself would now be impossible. Public attention having been directed to this, the council of the Inventors' Institute, in December last, devised a series of plans, providing, amongst other things, for the erection of an accessible and well-arranged Patent-office Library and Museum of Inventions immediately in the rear of the present National Gallery in Trafalgar-square. The leading feature, however, of their plans was to promote the erection of a building, or blocks of buildings, in a central position, in which might be located the various representative scientific, literary, and art institutions now scattered over all parts of London, thereby providing an appropriate habitation for science, literature, and art in all their varied branches; the erection of a national gallery of paintings and sculpture worthy of this great metropolis, together with an accessible and well-arranged Patent-office library and museum of inventions, comprising a complete record of that inventive and industrial progress which has so long maintained the pre-eminence of this country amongst the nations of the earth. Land sufficient for the purpose, immediately in the rear of the present National Gallery, was surveyed, and the total cost of purchasing a site of about five acres was estimated at about £700,000. A building suitable for the purpose, covering that space and the site now occupied by the National Gallery, with a frontage to Trafalgar-square, forming a fit adornment of one of the noblest sites in Europe, could be erected at an estimated cost of about £500,000. The Inventors' Institute plans also involve and provide for the construction of a magnificent new street, extending from Agar-street, Strand, to the top of the Haymarket, by Coventry-street. This street would be practically on a level, and well calculated to relieve the accumulation of cross traffic which will occur and be severely felt when the railways now in progress in the neighbourhood of Charing-cross are completed. A large portion of the new street would form the back of the proposed new building, and a plot of ground on the other side would be available for the erection of a new barracks.

A deputation of the council of the Inventors' Institute, introduced by Lord Richard Grosvenor, M.P., submitted these plans, about two months since, to her Majesty's First Commissioner of Works, and suggested that the accumulated surplus income of the Patent-office, now amounting to nearly £300,000, should be devoted towards the erection of a Patent-office Library and Museum of Inventions on the proposed site; but the Government being then apparently in favour of removing the National Gallery to Burlington House, and the Patent Museum to South Kensington, no definite satisfactory result could then be obtained. Subsequently a committee was moved for in the House of Commons, and appointed "to inquire into, and report upon, the necessity for the erection of a new Patent-office Library and Museum of Inventions," and the Inventors' Institute deputed two of their council, viz., Sir David Brewster, K.H., LL.D., F.R.S., and Robert Richardson, Esq., C.E., to give evidence in favour of their proposals. Sir David Brewster, in his evidence before the committee, gave it as his opinion that the whole expense of the site, and of erecting the proposed buildings, might, if necessary, be defrayed within a limited number of years, by holding in the buildings, and in the court-yard and open space around them (which might be temporarily glazed over for the purpose) periodical exhibitions of the art and industrial products of the country, small sums being charged for admission, as in the case of the Great Exhibitions of 1851 and 1862. He also stated that the stimulating effects of such exhibitions, if held in so central a position as Trafalgar-square, and conducted by Governmental authorities, aided—as then they might be—by the concentrated scientific, literary, and art intellect of the nation, would develope the manufacturing interest of the country to an almost incalculable extent.

Mr. Richardson stated, in his evidence, that although he recommended the adoption in their entirety of the Institute's comprehensive proposals, yet he thought that inventors would be satisfied if only such a portion of the complete plans as would provide a suitable Patent-office, Library and Museum of Inventions in the rear of the National Gallery were in the first place carried out. A site in the rear of the National Gallery, sufficient for such a Patent-office Library and Museum, would be less expensive, he stated, than any of the other sites which had been suggested. It would be more readily accessible to inventors and the public, and by bringing the proposed Museum of Inventors into immediate proximity with the galleries of our art institutions, would present advantages which no other site could afford

L. Marsden Latham,
Secretary to the Inventors' Institute.

PARLIAMENTARY NEWS.

INTERNATIONAL TELEGRAPHIC COMMUNICATION.

Sir C. Douglas asked the Under-Secretary of State for Foreign Affairs, if the French government had addressed a circular to the various powers, inviting them to participate in an international congress, for the purpose of regulating telegraphic communications in Europe; and if so, whether her Majesty's government would comply with that proposal.

Mr. Layard said that he had seen it stated in the newspapers that such a circular had been issued; but no copy of it had been sent to the British Government; and for this obvious reason, that telegraphic communication in this country was in the hands of private companies, while in the other states it was entirely under the control of the respective governments. He was not aware whether any communication had been made to our telegraph companies.

TELEGRAPHIC NEWS.

Electric Bells.—Messrs. Moseley & Son, of King-street, Covent-garden, have been appointed sole agents in England for Grenet's electric bells.

The Main Sewerage of London.—Between the chief pumping stations attached to the above great undertaking, electro-telegraphic communication will be provided, so that in case of an accident taking place at any particular station, an instantaneous notice thereof can be given to all the others.

Electric and International Dramatic Club.—In our brief critique on the late performance at the Cabinet Theatre, we omitted to award the credit due to Mr. James Cook for his able representation of *Carlitz* in "Love in Humble Life." The arduous character was sustained throughout with consummate ability. Mr. Cook's personification evinced dramatic talent of no mean order, and was warmly applauded.

Electric and International Telegraph Company.—The directors have resolved to recommend to the proprietors, at the general meeting to be held on Wednesday, the 3rd of August next, to confirm a dividend of £4 per cent. for the last half-year. We regret our inability to publish the report and accounts of this company, as we have done on previous occasions, because on application at the chief office for a copy of the same, a few hours before we went to press (and within four days of the date for which the meeting is announced), we found that the report and accounts were not printed.

Conversazione at St. Bartholomew's Hospital.—On the 22nd inst., by invitation of the treasurer, a brilliant *conversazione* was held in the hall of St. Bartholomew's Hospital. The hour named was nine o'clock, and soon after that time the large hall was thronged with a distinguished company, while long after ten the carriages continued to roll up to the doors. In the great square the electric light shed its dazzling rays upon the noble fountain, which plashed amid the trees that adorn the quadrangle, and brought into relief every detail of the architecture of this famous medical school and "town house" of charity. In a room on the ground-floor light refreshments were served, and the staircase was ornamented with a profusion of rare and beautiful flowers and shrubs. The great hall was a blaze of light, and on its walls were crowded paintings of great merit, both old and new. On stands about the room were exhibited a host of interesting and beautiful things—scientific instruments, among which Ross's microscopes were not the least attractive; paintings, miniatures, photographs, electric and magnetic telegraphs, whose tinkling bells were pleasant to the ear—in a word, everything that was likely to add to the enjoyment of men of science, or of the ladies who accompanied them. The *conversazione* was very charming, and it is no wonder that the visitors lingered as they did, chatting here, examining something of scientific novelty or importance there, and at the last the electric light lit them out of the great gateway thoroughly satisfied with the pleasure they had experienced.

Watson and Horwood's Electric Fire and Burglary Alarms.—These alarms, although of course unable to prevent the origin of fire, are nevertheless so complete in their construction, that, immediately upon the air of any room becoming heated above its natural temperature, it is announced by the ceaseless ringing of a bell, thereby allowing time for the preservation of life, with freedom from the agonizing sufferings too often attendant upon this most dreaded and desolating of all calamities; and also the removal of valuable property (without damage), which if once destroyed could never be replaced. The same continuous ringing also occurs upon the opening of any protected door or window more than the space of an inch, so preventing the ingress or egress of any person without an instantaneous alarm being given. The apparatus by means of which these important effects are produced is so simple in its construction, that it is manageable even by a child, and its operations may be suspended during the day, or when desired, by the turning of a small handle similar to that of an ordinary bell. The whole is neatly enclosed in an ornamental wooden case, to match the furniture of the room, within the small space of about twelve inches; and the communications throughout the house can be laid on without the slightest blemish to the decorations or inconvenience to the occupants. These alarms may be seen in operation at the office of the patentees, 51, King William-street, London.

THE BEHRING'S STRAITS TELEGRAPH.—Mr. Perry M. Collins is the projector of this great enterprise. The Russian Government is constructing a line across the continent of Asia to the mouth of the Amoor river, and from this point to the mouth of the Columbia is about 6,500 miles. It is this gap which the company of Mr. Collins proposes to fill. What they ask of Congress is the right of way across the public lands, the grant of a square mile of land at each station, the stations being 15 miles apart, and the payment of $50,000 a year for the Government use of the telegraph.—*Scientific American.*

THE MANUFACTURE OF THE ATLANTIC CABLE.—We are given to understand that this important work is progressing to the satisfaction of the Atlantic Telegraph Company. Last week several wire-covering machines were sent from the manufactory of Mr. A. Smith, Princes-street, Leicester-square, to the works of the Telegraph Construction and Maintenance Company, East Greenwich. The Great Eastern now lies in the Medway, and is being fitted with iron water-tanks, in which the cable will be coiled as it is perfected. The big ship is again an object of curiosity, and the available spaces in London are posted with large placards announcing cheap trips to the Medway and a view of the Great Eastern.

NOVEL RAILWAY BREAK.—A letter from Italy says that an ecclesiastic of Cagliari, one M. Garau, has most ingeniously applied the principle of electricity to the construction of a break for railway carriages. A single touch of the electric wire produces an instantaneous stoppage of the wheels, and, by a peculiar arrangement of the mechanism, M. Garau has succeeded in obviating the dangers arising from a sudden check in the movement of a train of carriages. The model certainly works most satisfactorily, and the invention has already attracted much attention in France as well as in Italy.

A NEW SUBMARINE VESSEL OF WAR.—Towards the close of last year the *Times*, in an article descriptive of Russian preparations for war, stated that one means of defence for the Neva, approved by the authorities, was a submarine boat, of colossal dimensions, in the construction of which 200 tons of iron and steel were to be employed. "Great secresy" the leading journal observed, "is being used about this boat." We can, however, state that it is to have engines worked by compressed air, to have a very strong beak, with provision for attaching large cylinders charged with gunpowder to the bottoms of vessels, to be fired by electricity. The parties navigating the vessel will see what they are doing by means of "bull's eyes," and they will be able to regulate the depth at which they swim, which will never be at any great depth from the surface.

MISCELLANEA.

RAILWAY CALLS.—The amount of railway calls falling due this month exceeds £1,500,000. This sum will raise the total subscribed from the 1st January to the end of this month to about £8,250,000.—*Economist.*

NEW SILVER COINAGE.—A contemporary states that it is in contemplation to recall the whole of the silver coins now in circulation, and to replace them by an entirely new coinage of that metal. The change is to take place ere many months shall have passed away.

BOILED TELEGRAPH WIRE.—Boiled wire is used by some telegraph companies, and the process of preparing it is thus described:—"The wire, in coils, is placed in a large iron cauldron, filled with linseed oil, and boiled about fifteen minutes, when it is presumed to be 'done.' By this process it receives a coat of glazing, which preserves it from rust. The wooden blocks, or braces, by which the insulators are placed, are also boiled, but in different material. They are made of sycamore wood, and are boiled—100 at a time—for a period of one hour, in ordinary coal tar. The effect of subjecting the sycamore to this process is to render it secure against warping or cracking from sun or rain."

SILVER ALLOYS.—Some new alloys of silver have been reported to the Academy of Sciences at Paris, by M. Peligot, the chemist to the French Mint, in consequence of the proposition of the Imperial Government to reduce the standard of the silver coinage. The new coinage was to consist of 835 parts silver, and 165 parts copper, but M. Peligot has made experiments to ascertain how the introduction of zinc, or the complete substitution of zinc or copper, would affect the alloy. He has found that alloys of the legal standard, in which part or the whole of the copper was replaced by zinc are remarkably malleable, and when rolled are perfectly homogeneous. They are of a beautiful white colour, but the binary alloy of silver and zinc are somewhat yellowish. The fusibility of the zinc alloys is greater than the copper; they are very sonorous and elastic, and if made brittle by hammering, the malleability is restored by heating. The study of the atomic alloys showed curious results. Equal equivalents of silver and zinc, or two equivalents of silver to one of zinc gave malleable alloys, while the compounds of one equivalent of silver and two equivalents of zinc, and also of two equivalents of silver and three equivalents of zinc are too brittle to be rolled. As a matter of economy, M. Peligot recommends that his government should employ zinc to reduce the value of the present money, the price of zinc being only one-fifth that of copper. Another recommendation to the zinc alloys, is the fact of its blackening less readily with sulphuretted hydrogen than the copper compound, copper indeed seeming to increase the discoloration. An alloy of 800 of silver and 200 zinc will keep its whiteness in a solution of polysulphide, which will rapidly blacken the legal alloy of copper and silver.

THE PASSIVITY OF METALS.—The change which metals seem to undergo through the action of certain agents has been studied by M. W. Heldt, who asserts that the phenomena are produced on the surface of certain metals whose nitrates are insoluble in nitric acid. It is to the insoluble layer produced that the "passivity" is due, and not to a peculiar electro-dynamic state, or to "polarisation." Those metals alone whose nitrates are soluble in dilute nitric acid, and insoluble in the concentrated acid, present these phenomena. In copper and tin the insoluble layer may be seen by the naked eye; in other materials it requires a glass. Acidulated water removes it easily, and the metal returns to its original condition.

LATENT HEAT.—The philosopher who first investigated the phenomena of latent heat, and who by the inquiry contributed so much to experimental philosophy, was Dr. Black, about the year 1757. Before this period it was supposed that the state of fluidity was occasioned by the addition of a very small quantity of heat to a solid, when once raised to its melting point, and this was, *primâ facie*, a reasonable supposition; it was also, and with equal appearance of probability, imagined that during the conversion no greater addition of heat was received than the thermometer indicated. It very frequently happens that facts which we have every day an opportunity of observing are disregarded, however curious they may be; whilst those that occur rarely are much more likely to arrest our attention. In consequence of this craving for novelty many highly interesting particulars escape us, till some master-mind, some philosophic spirit interposes, and opens from old materials a new and extensive field of inquiry. Thousands must have observed, before the time of Black, that however cold ice may be it soon becomes heated to its melting point when brought into a warm room, but that nevertheless it is a long time before it is entirely re-converted into water, and that a heavy snow always remains on the ground for a very long time after the breaking up of a frost, its re-conversion into water being exceedingly gradual. Now, if the state of fluidity be occasioned by a small addition of heat to a solid raised to its melting point, the ice and snow ought to vanish presently, the heat continuing to be accumulated from the air around. This occurred to Dr. Black, who immediately set about inquiring what becomes of the heat that must keep continually entering the ice, without producing its liquefaction. If a piece of ice be suspended in a warm room the effect of the warm air is rendered evident by the stream of cold air that constantly descends from it, and which may be felt on the hand. If the drops of water, as they fall from it, be received on the bulb of a thermometer, the instrument will indicate the same temperature as the ice itself, viz., 32°. Dr. Black made the following experiment:—He filled two similar globular glass vessels with water; one was afterwards frozen, and the other cooled as nearly as possible to the same point; they were then carried into a room the temperature of which was 47°, there being no other difference between them than that one contained water and the other ice. In half an hour the vessel containing the water had acquired the temperature of 40°, but in the other it required ten hours and a-half to melt the ice and to raise the water to 40°. Now the access of heat being in both cases the same, and at the rate of 7° per half hour, it follows that in twenty-one half hours (the time required to thaw the ice and elevate the temperature of the water to 40°) it would have received $7 \times 21 = 147°$. The difference, therefore, between the increase of temperature in the ice and water vessels, with equal accessions of heat, is *one hundred and forty degrees*, which will express the quantity of sensible heat rendered *latent* by the operation of liquefaction. The same number is brought out by other methods of experimenting. Equal weights of water at 32° and 212° will, as we have shown before, produce on mixture the mean temperature of 122°; but equal weights of *ice* at 32°, and water at 212°, only produce, after the ice has melted, a temperature of 32°; the water loses 160°, while the ice acquires only 20°. Now, 160°—20°, gives 140° as before, for the quantity of heat expended in changing the ice to water; for the quantity of latent heat on which the fluid state depends. But this heat is not annihilated, although to the feeling and to the thermometer it is insensible. This is proved by the following experiment, also made by Dr. Black:—When the thermometer stood at 22° in the open air he exposed two similar vessels, one full of water and the other of brine, both at 52°; both lost heat till they were cooled to 32°, after which the brine (which does not freeze till cooled down to 4°) continued to lose heat without interruption, and gradually reached 22°, the temperature of the air; but the pure water remained stationary at 32°, when ice began very slowly to form. Now, can anything be plainer from this experiment than that the reason of the water refusing all of a sudden to give out heat is, that its temperature was maintained by the heat which it absorbed during its liquefaction, and which it slowly evolved during its conversion into ice? Dr. Thomson has concluded, from many experiments, that the quantity of ice which forms suddenly on the agitation of water, cooled down below the freezing point, bears always a constant ratio to the coldness of the liquid before agitation, and that from analogy it was probable that for every five degrees of diminution of temperature below the freezing point, without congelation, one twenty-eighth of the liquid freezes suddenly on agitation. Therefore, if water could be cooled down twenty-eight times five degrees below 32°, without congelation, the whole would congeal instantaneously on agitation, and the temperature of the ice would be 32°. Now, observes Dr. Thomson, it deserves attention, that $5 \times 28 = 140$, gives us precisely the quantity of heat which, according to Black's experiments, enters into the ice, in order to convert it into water. Hence it follows that in all cases when water is cooled down below 32° it loses a portion of the heat which is necessary to constitute liquidity.—*Noad's Lectures on Chemistry.*

Very Fair.—A Cape of Good Hope paper states that Port Elizabeth has a population of 21,000. It has four banks, three episcopal churches, fifteen dissenting churches, a theatre, an opera, a public library, a college, two literary institutions, and an electric telegraph *in esse* and railways *in posse*. There are seldom less than thirty ships in the bay.

Conscience Money.—The moneys remitted to the Chancellor of the Exchequer by sundry persons for conscience' sake in the past financial year, ending the 31st of March, amounted to £7,400. In the previous year conscience rendered up £10,422. From this statement it would appear that we are either more conscientious or less honest this year than last.

Wire Tremors.—Comparisons and registration of wire disturbances, or earth currents, have induced me to believe that they are all electro-magnetic, occasioned by action of atmospheric currents, and, consequently, only indirectly caused by solar action. I believe that whenever the magnetic instruments of observatories have been affected (as in a magnetic storm), and whenever telegraph wires have vibrated to nature's operations, or have been disturbed by earth currents (so called), there has been a concussion, a commotion, or a much developed antagonism of air currents, somewhere within the farthest atmospheric limits, if not within a hemisphere. A spider in its web "feels at each thread, and lives along the line." Does not the earth—even more than the telegraph wire—conduct electric or magnetic influence? Is not an earthquake felt, even by the vibration alone, thousands of miles? And can a violent explosion—lightning and thunder—anywhere fail to cause vibratory or electric effects in some if not in many directions? —*Admiral FitzRoy*.

Amber.—This is a subject on which a great deal has been written. It has generally been classed among minerals, although avowedly originating from the vegetable kingdom. Nothing as yet as afforded a clue to the plant that may have produced it; nor has any plausible conjecture been formed from the flowers and insects sometimes imbedded in its mass. Its peculiarly resinous nature seems to point to some *Hymenœa* or to the *Binu Daunnara* as the parent plant; but there is no perfect identity between the produce of these genera and amber. Nor is it certain that all kinds of amber proceed from the same source; for its aspect often varies considerably, according to the beds in which it is found, which circumstance has led many naturalists to the belief that there are several amber-producing plants. In a paper addressed to the Academy of Sciences by M. Bandrimont, the composition of this anomalous subject is examined. Recluz has has already shown that white and opaque amber contains more succinic acid than the perfectly transparent yellow sort; Drapiez had analysed it and found it to contain carbon, hydrogen, and a small proportion of ashes, consisting of lime, alumina, and silica. M. Bandrimont, however, shows that it contains another element not hitherto mentioned, viz., sulphur. If a few fragments of amber be subjected in a test tube to a heat of distillation, and paper impregnated with acetate of lead be immersed into the white fumes evolved, it immediately turns black, thus unmistakeably denoting the presence of a sulphuretted compound. The proportion of sulphur contained in amber is not, however, very considerable, since our author fixes it at somewhat less than one half per cent. But under what form does it exist therein? Is it contained in the essential oil, or in the two soluble resins, or in the insoluble bitumen contained in the amber? M. Bandrimont does not tell us, but states that most certainly it is combined with organic matter, because it is evolved under the form of hydrosulphuric acid. —*Galignani*.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1804. H. E. F. De Briou, protecting and preserving metals, such as iron, copper, and zinc used in the construction of ships, or in the protection of their sides and bottoms from oxydation and corrosion from the action of the sea water; and for protecting all submerged substances, such as chains, anchors, cables, and every oxydable metal submerged in water or exposed to atmospheric influences.

1820. W. Booth, rendering security to railway travelling by effecting ready and easy communication between the guards, passengers, and engine-drivers on railway carriages, or other public conveyances where the same may be applicable.

1823. A. V. Newton, improvements in electro-telegraphic apparatus.

1840. P. Æ. Le Boulengé, an electro-balistic chonographe.

NOTICES TO PROCEED.

661. E. F. Ruffin, improvements in marine and land signals.

680. W. A. von Kanig, improvements in railway telegraphs and signals, and also in the permanent way and carriages for preventing railway accidents.

758. T. W. Rammell, improvements in pneumatic railways and tubes, and apparatus connected therewith.

PATENTS SEALED.

241. N. J. Holmes, improvements as applied to the regulation of machinery for covering telegraph cables, wires, and other similar articles.

244. G. Canouil, an improved alarum and signalling apparatus.

260. E. T. Hughes, improvements in submarine batteries.

PATENTS WHICH HAVE BECOME VOID.

1772. T. Cobley, improvements in the manufacture of metallic and earthy silicates, or siliceous compounds of the same, from the metallic and earthy bases or their salts and soluble alkaline silicates, the formation of alkaline acetates or caustic alkalies, and application of the same.

PATENTS ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1907. J. Rylands, T. G. Rylands, and P. Rylands, improvements in joining wire for telegraphic conductors and other purposes.—31st July, 1861.

PATENTS ON WHICH THE STAMP DUTY OF ONE HUNDRED POUNDS HAS BEEN PAID, AND DATES OF THEIR PRODUCTION FOR CERTIFICATE.

1998. F. H. Holmes, improvements in magneto-electric and electro-magnetic machines.—20th July, 1857.

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5	United Kingdom Telegraph .	3	2 to 1 dis.	—
10	Mediterranean Extension Tel. .	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{1}{4}$ dis. to $\frac{1}{4}$ pm.	—

TO CORRESPONDENTS.

J. H. W.—We will supply the necessary particulars through the post.

W. T. Henley.—Too late for insertion this week. We go to press on Friday forenoon.

R. F. Murphy.—The cable you refer to was subjected to a variety of tests in our presence, but all efforts to get a "kink" in it proved unavailing.

T. R. S.—Make your case known to the manager, and if he does not remove the nuisance, write us again.

Eugene F.—The conduct of the said manufacturer is unworthy of consideration. He has lost his temper, and we shall leave him in peace to find it.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

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FORCE AND FORM.

CONTRIBUTED BY B. M.

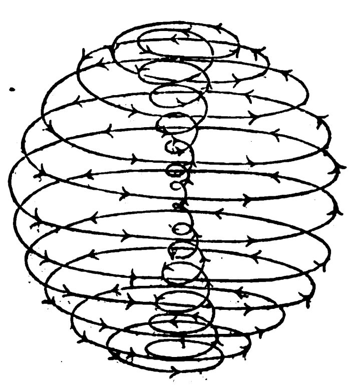
IV.

WITHOUT going at present into the proofs of the forms of active force, or, if you like it better, the forms of motion, I will try to set forth by delineation and description what I mean by an atom; as being force in a form; that is, as I understand it, as set forth by its author, though he in his day had no idea of the confirmations, that we now have in electro-magnetism, and in our better acquaintance with electricity and magnetism. This accumulation of knowledge, no doubt, has led our leading scientific men towards the rejection of the Newtonian hard dead atom, as the present theory of light has caused his vacuum to be rejected. One wonders how such a notion could ever have been held. How could one body act upon another at a distance without the intervention of a nexus? There could be no such thing as attraction and repulsion. It would be simply, as the Rev. W. Jones of Nayland has put it, "a *pulling* without any hold, and a *pushing* without touching." But the hard dead atom requires the vacuum, and the vacuum the hard atom; they are essential to each other. If there is no vacuum, then there can be no hard, unyielding atom, else our universe would be one hard, dead, solid mass, where there could be no motion, no life—a universe of solid brass. But as it is agreed that there is a plenum, and we still have life and motion, let us try to understand how that is, and not only that, but how *force induces force*, for this is the whole question at present exciting so much interest and so much discussion, and is set forth under so many forms, such as "co-relation of physical forces," "mechanical equivalent of heat," "the laws of energy," "electro-magnetism," "magneto-electricity," "static electricity," which is divided into so-called "resinous and vitreous," "law of charge, discharge, and retardation," as applied to electricity, and a wilderness of other laws and forms and special instances; all good as material, but as laws and formula, rubbish! No wonder our telegraph men speak of electricity as if it were beer or broth, and of magnetism as if steel could be soaked in it and become saturated. Of experience and experiments we have at present an *embarras des richesse*. We want now a little digestion of these crude material, and then a little assimilation. A true law of force in effort and in act will be our solvent. Then induction, conversion, and co-relation will become understandable. To understand this matter we must begin at the beginning, we must begin with the atom, which according to our theory is *force in a form*. I know of some who say, "We cannot understand your atom; it begins in nothing and ends in nothing. Give us Newton's sensible, solid piece of matter, which the mind can grasp; not so *your* atom, which is an aggregation of points, and a point has neither length, breadth, nor thickness; consequently is nothing." I can only say to this that it is not the theory of an atom as propounded by Swedenborg, or Boscovich, or as understood by Faraday, and I can only wonder that, after having read any one of these authors, it can be so understood. What they say is, that an atom is a centre of force, and of course a centre is a point; but the centre of every solid is a point; but the solid is not therefore made up of points. Now, as far as understandability goes, what difference between the hard incompressible atom and our soft and yielding one? Nay, since a vacuum is untenable, the yielding elastic atom can be easily understood, but the other cannot possibly. And even if it could, and simply because it has length, breadth, and thickness to begin with, why so has ours. "Oh, but you begin in a point;" and so does the form of your hard, impenetrable atom begin in a point too; and if you take away the form of your hard atom, what have you left of it, but hardness, and deadness, or, what is the same thing, inertia; but deadness is nonentity or nothingness, and what is hardness if it is not resistance or force? So that you see if your atom is not force in a form it is nothing.—Q. E. D.

If there is such a thing as force extant in nature, then it must begin to evolve itself a form in a point, for all form must begin there; so says geometry, and if that is not satisfactory, then I suppose our confidence in the multiplication table also is entirely misplaced.

Now, as I have every belief in the multiplication table and in the axioms of geometry, I shall take them for granted as heretofore; therefore our force begins to evolve itself a form in a point. If force begins to exert itself in a point, then it must be by certain effort or tension, and it is clear that this tension must be in every direction, because this point is the initiament of a solid; therefore its fluxion must be in three directions corresponding to the three dimensions of a solid, namely, length, breadth, and thickness. Not only that, but it must be in such a form that it can be a living and active force under all circumstances: it may be passive relatively, but active absolutely; for quiescence is death to the higher order of beings, and to simple matter it is annihilation. Now, to fulfil these conditions there is only one form that I can conceive, or that seems to be possible, namely, the perpetual spiral, or vortical, as it has been called. The annexed figure shows the fluxion of the vortical.

N



S

In this figure is indicated the external spiral of the sphere and its polar cones. The atom as here represented is the microcosm, of which the earth is the macrocosm, and will go far to explain the apparent anomalies of the magnetic polarities of the earth, if the base of the north polar cone be taken to represent the parallel of latitude in which the earth's north magnetic pole is apparently situated, or north magnetic poles, as some have imagined to have observed, yet from the very nature of attraction one would have supposed that no one could have entertained such a notion; for two polarities of the same name could not exist

together without coalescing, and two of opposite names could not without neutralizing each other; but the poles cannot be of the opposite names, for the earth's magnetism is not neutralized; and if it were possible that there should be two of the same name, they would coalesce, therefore no indication of duality from that cause could be given, consequently the apparent indications of duality must be referred to some other cause. Magnetism abundantly proves what is here stated.

These, and other apparent eccentricities of the magnetic meridians, have been accounted for in another manner by the first propounder of this theory of atomic motion. He affirms that the magnetic poles of the earth coincide with the poles of the ecliptic; therefore, the poles of the earth revolve round the magnetic pole, that the north pole makes one revolution in 386 years, and the south in 1,080 years; and he says that these will form a cycle of 5,400 years, and this he considers to be the principal cause of the magnetic variation. On these data he has calculated the variations for several places down to the 20th century; but many of his results differ widely from the variations as since found by observation. Even if this were the reason of the magnetic variations, his results could not very well be correct because of errors, and of disturbing causes of which he has taken no note. For example, he states that the periods 386 years and 1,080 years make a cycle of 5,400 years; but they do not, for though in that time the south pole would have made five revolutions, it would take four years more for the north pole to make fourteen revolutions, consequently at the end of 5,400 years they would not be in the same relative position as at the beginning. Instead of a cycle of 5,400 years they would form one of 104,220 years. He also takes the ecliptic to be at an inclination 22° 30′ to the equinoctial, but it is at an inclination of 23° 28′; besides he takes no note of *precession* and *nutation*.

Precession is a motion of the earth's poles round the poles of the ecliptic at an angle of 23° 28′, but evidently distinct from the one stated above, its period being upwards of 25,000 years; and nutation is an undulating movement given to that course, taking nineteen years to complete a concave and a convex undulation. These errors and omissions, of course, would vitiate the result, if even the principles on which the calculations are based were correct in the main. But the greatest difficulty to me is to understand how one magnetic pole can revolve more than twice as rapidly as the other. I have no mechanical formula to reduce that to, therefore to me it is just unintelligible. However, for the present we will leave these speculations, and return to our figure of motion. Beginning, then, at the *point*, the centre of the sphere of force, it begins to actuate itself in motion, thence flowing in a spiral cone to the extremity of its sphere of potency, then recurving and flowing in a spherical spiral over the circumference of its sphere of potency to the opposite pole, where it re-enters by a similar cone from circumference to centre, thence to renew its course to the circumference as before in endless gyrations; and this is the most perfect form of motion, the perpetual vortical. Of course this form of motion is not really progressive in its formation, as is made apparent by this description, no more than a solid is by the progressive description from point, line, surface, to full form, but being the simplest of all entities *is* not bing composed of parts that can exist apart from the whole, and this description is simply that of its fluxion.

Now, it will be seen clearly from this figure of motion that the like poles of two such atoms must repel each other, whether they be the poles of issuing or entering force, for in both cases there are two opposing forces either central or circumferential. It will also be seen that at each pole the force moves in two directions. At the issuing or north pole, taking the earth's polarity as a standard, it not only flows out from the centre, but recurves and flows back over the circumference; and at the south pole this circumferential force again recurves and flows back to the centre. It will be as clearly seen by an inspection of the figure that the unlike poles must attract each other, for not only will the central spirals coincide, but will mutually flow into each other; the circumferential spirals will also do the same, and this will produce a mutual approach of their centres and a coalescence of their spheres. All this will be easily understood by an inspection of the direction of the arrow-heads in the figure. These are the first essentials to be understood of a unit of force in a form, namely, the mode of its actuation into a solid, and of its mode of coligation with other atomic solids.

EXTENSION OF THE TELEGRAPH.

Our own correspondent at Natal, in the letter published in our last, appeals to the liberality of the inhabitants of this colony in the matter of the extension of the electric telegraph to D'Urban. We are not disposed to underrate the advantages which we should enjoy by the construction of a line of telegraph to the sister colony, nor will we say the Parliament should be grudging in granting the required help; but previous to any farther monopoly being granted to the existing company, or any other company which may be formed, a clear and definite understanding ought to be come to as to the precise benefits which the contracting parties are to secure to each other. Unfortunately for the Cape, when the Parliament had under its consideration the terms upon which the line between Cape Town and Graham's Town should be constructed, a deaf ear was turned to the arguments of those who maintained that the work was one which ~~should be undertaken~~ without the help of a company, the Government itself constructing and working the line. One or two of the members of the Assembly, it will not be forgotten, allowed themselves to be button-holed and talked over by the gentleman who, report says, subsequently made such a good thing of the transaction; and the upshot of the whole is, that the colony has to pay an annual subsidy of £1,500 for the transmission of Government messages, and when private individuals have to use the line, they are subject to a rate of charges which we believe to be without a parallel in any other portion of the globe. We are far from saying that the Government could have constructed the existing line for the same sum as it has cost the company; indeed, it is highly probable, if it is not absolutely certain, that the figures would have borne no proportion to each other; but what we do say is, that whenever an extension of the line is spoken of, it must be regarded as a *sine qua non* that the existing scale of charges is not to apply to any additional length of line. We fear that it is too late now to argue that the fees for the transmission of messages between Cape Town and the other stations ought to be modified except, perhaps, in one respect; the colony has made its bargain, and to it we must adhere. But if the Parliament is solicited to grant an extension of what is to all intents and purposes a monopoly, the interests of the tax-payers must be more closely looked after. Even now we have reason to hope that if a pressure were brought to bear upon the Government, it might turn out that the rule by which the name and address of the person dispatching, and that of the person receiving the message, are treated as forming part of the message itself, was an after-thought, and we should be glad to find that one of the members of Parliament had moved for the production of the correspondence between the Government and the manager of the company upon this point.

In connection with this subject, we may again direct public attention to the discussion which recently took place in the House of Assembly upon this item in the estimates, in the course of which the Colonial Secretary accounted for the excess in the present charges, over those estimated by Mr. Wollaston two or three years ago, by saying that the line had cost in the construction three times the amount first put down. In reply to this, one of the members of the Assembly asserted that the line had been completed within the estimated sum, and the statement was allowed to go forth uncontradicted. Now, at first sight, it would appear as if both these statements could not be correct, but that if Mr. Rawson was right, Mr. Wood—for we think it was he who replied—must be wrong. A moment's consideration, however, may tend to clear up the discrepancy, and we think we are not far wrong when we conclude that Mr. Rawson's figures included the very handsome douceur which is said to have been paid to Mr. Pickering by the company, while Mr. Wood's only embraced the actual money spent on the work of construction and in the purchase of instruments

and other materials. Again, the Colonial Secretary stated, in the course of the debate, that during the time which had then expired, subsequent to the opening of the line, the government had transmitted or received messages, which, if paid for at the scale charged to the public, would have fully made up the amount of the annual contribution. There can be no doubt but that the greater part of these messages was rendered necessary by the fact of Parliament meeting for the first time in Graham's Town, and the sum of £1,500 is doubtless made up by including the two or three *Gazettes Extraordinary* which were transmitted in this way to checkmate the late litigants in the matter of "the obnoxious resolution," and to enforce the new tariff of customs dues. In future sessions, we may be allowed to hope that the same necessity will not exist for such lengthy messages between Cape Town and the other end of the line; for even should the next Parliament assemble in Graham's Town—a contingency which we neither expect nor fear—we trust that no *ex post facto* Acts will render the ordinary communication by post too slow for the purposes of Government.

There is also another point which must not be overlooked in the event of a further contract being entered into with a foreign company, whereby we are sanguine a good deal of the uncertainty in the transmission of telegrams would be avoided. The imposition of a fine for every day during which the communication was interrupted would only be a fair and equitable arrangement. The present company has been fortunate enough to secure a contract on far more favourable terms than would ever be given again, but the colony will have gained experience from the working of the existing line, and future negotiations must be conducted on a totally different basis.—*Cape Argus.*

REPORT OF THE DIRECTORS OF THE UNITED KINGDOM ELECTRIC TELEGRAPH COMPANY, LIMITED.

When the directors met the shareholders at the last annual general meeting they were anticipating the speedy opening of the Company's second trunk line to the north, and the completion of the local subscriptions to enable them to extend the Company's wires into South Wales and the West of England.

At that time the entire working system of the Company was comprised in the single line of electric telegraph between London, Birmingham, Manchester, and Liverpool, and the necessity to include the whole of the large telegraphing towns in the country was becoming daily more apparent.

It was felt both by the shareholders and the directors that to make the uniform shilling rate successful it must be widely applied, so as to ensure the reciprocal action of the large towns the one upon the other.

It was thought practicable to complete the main lines, embracing all the chief towns, last half-year, but various causes have prevented this, and it was not until May that the northern, and June that a portion of the South Wales and western section were opened for business.

From this cause the operations of the Company have not been on the extended scale that the directors anticipated they would be, although the Company has erected and opened within a limited period a system such as has previously required several years to construct.

The directors are happy to state that they have completed the subscription for the South Wales and the West of England lines, and that the necessary funds are subscribed to enable the Company to extend to Paisley, Greenock, Stirling, Perth, Dundee, Arbroath, Montrose, and Aberdeen.

The Company's lines will thus run from Aberdeen in Scotland, by Glasgow and Edinburgh, to London, and to Swansea in South Wales, and Plymouth in the West of England.

Since the directors last met the shareholders, the works completed and now in operation are as follows:—

The section from London to Leeds, and across to Hull and Manchester, and Wakefield to Manchester, connecting Barnsley, Beverley, Bradford, Chesterfield, Halifax, Huddersfield, Leicester, Loughborough, Mansfield, Northampton, Nottingham, Rochdale, Selby, Sheffield, and Todmorden, opened between the months of October and March last.

The section from Wolverhampton to Manchester, embracing Burslem, Congleton, Hanley, Macclesfield, Stafford, and Stone, opened between the months of October and March last.

The section from Leeds to Newcastle-on-Tyne, embracing East and West Hartlepool, Middlesboro', Stockton-on-Tees, Sunderland, and Thirsk, opened in February and May last, and in the present month.

The section from Newcastle-on-Tyne to Edinburgh and Glasgow, embracing Falkirk, opened in May last.

The section from Oxford to Bristol and Cardiff, embracing Gloucester and Newport, opened in June last.

The mileage of the Company in operation this time last year was 370 of line and 3,020 of wire; it now amounts to 1,305 of line and 7,591 of wire, and, on the completion of the Company's lines at present begun or undertaken, will reach 1,658 miles of line and 9,316 miles of wire.

It will thus be observed that many of the most important towns have been only very recently brought into operation. No conclusive evidence could therefore be obtained in the twelve months ending the 30th June of the practical working of a low uniform rate, and the directors, following as they conceive a wise policy, determined to adopt the same course as last year, and place all earnings and expenses to the credit and debit of the construction account, without attempting a division, which the amount of work to be got through, and the early period at which it was necessary to call the meeting, rendered almost impracticable.

The shilling rate has only now been extended over a sufficiently wide area to prove its capability of becoming remunerative; and the public have, so to say, had to be educated to its uses.

Since the more recent extensions of the Company have been completed, however, the increase in the traffic has been considerable, and at particular points, and on certain lengths, the directors have already made arrangements to increase the working powers of the Company's system.

Thus two additional wires are being run from London to Nottingham, three from Nottingham to Wakefield, and four from Wakefield to Leeds.

Four additional wires are being run from Birmingham to Wolverhampton.

A line of seven wires is nearly finished from Liverpool to Warrington.

The directors are also now arranging to run more wires from Newcastle-on-Tyne to Glasgow.

These additional works have somewhat interrupted the Company's business, but they were imperatively needed. The directors believe that the shareholders will approve the policy of giving every accommodation and encouragement to the full development of the system.

By these means the Company will have better duplicated and more effective lines, with a far greater number of wires than was originally contemplated, and will give to Liverpool, Manchester, Glasgow, and other places, additional direct communications, the want of which is at present found to be a drawback to the Company's operations.

The lines west of Bristol are progressing rapidly towards Plymouth, and from Cardiff towards Swansea.

The extension to Dundee and Aberdeen is commenced, and will be speedily completed, arrangements having been made with the Scottish Central and North-Eastern Railway Companies for the use of their lines. The erection of the wires to Greenock, North Shields, and one or two other important places contiguous to the Company's present system, is all that remains to be accomplished.

The capital of the Company on construction account amounts to £213,133 8s. 4d., the remaining lines and extra works will be completed for £25,000, and the Company's capital will thus be £238,133 8s. 4d. For this the Company will possess 1,658 miles of line, and 9,316 miles of wire, and the working plant.

The property of the shareholders, therefore, will have been created at less expense than that of any existing Company, although the lines, apparatus, &c., are of the most efficient and improved description, and the system comprises only trunk lines to all the large towns.

The Company possesses in the large telegraphing towns a numerous constituency, amounting to 1,143, mostly consisting of persons using the wires.

Under these circumstances, the country has now an unusually favourable opportunity to secure a low, uniform charge in its telegraphic, similar to that in its postal, arrangements; and on the public it now depends to establish the permanency of the system in the one as in the other department of communication.

Henry J. Leeke, Chairman.

237, Gresham House,
Old Broad-street, London, July, 1864.

BALANCE-SHEET OF THE COMPANY FOR THE HALF-YEAR ENDING 30TH JUNE, 1864.

Dr.

	£	s.	d.	£	s.	d.	£	s.	d.
To share capital received as under:—									
First deposit on 26 006 shares				13.003	0	0			
Second „ 26,006 „				13,003	0	0			
First call 25.925 „				25,925	0	0			
Second call 25,702 „				25.702	0	0			
Third call, paid in advance				15,888	8	0			
Fourth call, „ „				11,188	7	0			
				104,709	15	0			
Arrears per contra, viz.:—									
On first call	5	0	0						
On second call	65	0	0						
				70	0	0			
							104,779	15	0
To bills received in anticipation of calls							8,261	8	6

MEMORANDUM.—SUBSCRIBED CAPITAL.

	£	s.	d.	£	s.	d.
Shares.						
Received as above	104,709	15	0			
Bills	8,261	8	6			
	112,971	3	6			
Arrears	70	0	0			
Calls on 26,006 shares	16,988	16	6			
320 shares agreed to be taken up	1,600	0	0			
292 „ „ contingent upon extension of lines	1,460	0	0			
Share capital, received or subscribed				133,090	0	0
Bonds.						
Received as under	29,268	0	0			
Calls made and to be made	20,467	0	0			
Bonds agreed to be taken up, contingent upon extension of lines	400	0	0			
Bond capital, received or subscribed				50,135	0	0
				£183,225	0	0

	£	s.	d.	£	s.	d.
To loans and interest				28,037	5	4
„ Debentures	15,900	0	0			
„ Bonds (interest payable in message stamps)	29,268	0	0			
				45,168	0	0
To sundry creditors:—						
Bills payable	28,769	7	3			
Sundry balances	7,772	16	7			
Stamps issued not yet used	1,242	5	3			
				37,784	9	1
				£224,030	17	11

Cr.

	£	s.	d.	£	s.	d.
By construction of works for amount expended as under, viz.:—						
Cost of materials, instruments and patent rights, labour, "consents," maintenance, direction, interest, and general expenses	220,181	4	9			
Law and Parliamentary expenses	11,709	15	5			
Rents of canals and housetops	6,145	16	8			
	238,036	12	10			
Less receipts for messages, &c., to this date	32,012	2	4			
				206,024	10	6
By preliminary expenses				3,799	10	3
By fixtures and furniture at central office and stations	3,309	7	7			
„ stock of materials on hand	3,764	13	0			
				7,074	0	7
By lease of Leeds Central Station				350	0	0
By cash at bankers	3,469	9	7			
„ „ in hand	484	7	5			
„ „ at stations	125	12	6			
				4,079	9	6
By sundry debtors:—						
For arrears of calls per contra	70	0	0			
Sundry balances	2,633	7	1			
				2,703	7	1
				£224,030	17	11

Examined and found correct,

AUDITORS. { THEODORE B. JONES, of the firm of Theodore Jones & Co., Accountants, Moorgate-street.
P. STACE, Accountant, 15, Queen-street, Cheapside.

21st July, 1864.

ANNUAL MEETING OF THE UNITED KINGDOM ELECTRIC TELEGRAPH COMPANY.

THE annual general meeting of the shareholders of this company, to receive the directors' report and statement of accounts, and for the transaction of the usual business of the undertaking, was held at the offices of the company, Gresham House, Bishopsgate-street, on Saturday last, the 30th July. There was a numerous attendance of shareholders, and the following directors were present:—Alexander Angus Croll, Esq., deputy-chairman; Lord Alfred Spencer Churchill, M.P.; Robert Bryce Hay, Esq.; and W. H. Schenley, Esq. In the absence of the chairman of the company, (Admiral Sir Henry Leeke, M.P.), the chair was occupied by ALEXANDER ANGUS CROLL, Esq., C.E., the deputy-chairman.

The CHAIRMAN.—The secretary will read the advertisement convening this meeting.

Mr. ANDREWS, the secretary and manager of the company, read the advertisement by which the meeting was convened.

The CHAIRMAN.—The secretary will now read the report of the directors. (Given above.)

The CHAIRMAN.—He was very sorry they had not the presence of their chairman on that occasion; Admiral Sir Henry Leeke, however, had become so wearied out with the labours he had undergone in his legislative capacity that he had retired into the country in order to have a little requisite rest. The report which had just been read by the secretary gave such precise and complete information regarding the operations of the company, since the directors last had the opportunity of meeting the shareholders, that he should not have to trouble them with many observations of his. He could not help, however, expressing the gratification he felt in congratulating the shareholders on the present position and future prospects of the company. It was quite true that it would have been much more pleasing and agreeable to the directors to have met the shareholders with a report recommending the declaration of a dividend. He hoped and trusted, however, that no other meeting of the kind would be held at which the declaration of a dividend should not be associated with it, and he believed the time was not far distant when they should be able not only to declare a a high and satisfactory dividend, but also to pay back dividends from the first time that calls on capital account were made. (Hear.) These expectations were founded on what the company was doing at the present moment, on anticipations of a fair and reasonable increase of business, and on further income from the regular use of the additional wires that would be shortly put in operation. He held in his hand a statement of the number of messages which had been sent by the company during the last four weeks, since the more distant portions of the line had come into use. He found that during the past four weeks the company had forwarded 50,000 messages, and that during the corresponding period of the preceding year they forwarded 14,500. At that time last year they had in operation 370 miles of line, and 3,020 miles of wire, and now they had 1,305 miles of line, and 7,500 miles of wire. Now if they allowed the same increased proportion of messages to take place for the additional mileage about to be brought into operation by the company, if the number of messages increased in a similar ratio to what had been experienced hitherto, the result would be that the number of messages transmitted would amount to 77,469 per four weeks, or twenty-four working days. By adding to that number 15 per cent. to bring the messages into shillings, because they found that there was a sufficient number of messages longer than twenty words to make 15 per cent. a fair average, a result would be obtained of 88,000 shillings for four weeks, and multiplying that number by thirteen—the number of four weeks in a year—the result would be 1,141,800 shillings for the year, or £57,000 per annum. He had also another statement before him relating to the expenses of conducting the operations of the company. With the increased mileage the cost would be £31,919, thus leaving a large surplus to pay interest upon debentures, upon bonds, and a 10 per cent. dividend to the shareholders. Now, to give the meeting some conception of the way in which the expenses had been made up, to show the shareholders in fact that the directors had made a most ample allowance for all the probable expenditure, he would lay before them a few of the items making the total which he had mentioned. For advertisements the sum of £200 was put down; they anticipated that the cost of advertisements would come to £200. Now he thought they would all allow that £200 per annum was a large and liberal allowance for advertisements. For postages and stationery—and they all knew that postage was very cheap—they put down the sum of £400 per annum, as the probable cost under this head. For printing and stationery they put down £2,500. They all knew what a great quantity of books could be purchased now, including payment to authors, for £2,500, but they had put down the charge for printing and stationery as £2,500, and, including £1,000 to the directors, the whole of the items set down as expenses amounted to £30,919. Now, if they deducted £30,919, the estimated amount of expenses, from £57,000, the estimated amount of income, a sufficient margin was left to pay all claims and a good dividend, and he believed—he did most thoroughly believe, for he had carefully analysed the whole of the details—that when they met there that time next year they would find the anticipations which he had expressed fully realised, and that the number of messages transmitted by the company would be what he had stated. There was another point to which he desired to call the attention of the shareholders, and that was to the system or principle on which the company had been established; namely, the low, uniform charge of one shilling for messages of twenty words. From an account furnished to him he found that the number of messages which had been forwarded to their most distant opened station, namely, Glasgow, which was opened sixty-five days ago, was 11,545; they had increased since the commencement; the messages had now increased something like 50 per cent., but, taking the sixty-five days, the number of messages transmitted was 11,545, or at the rate of 177 per day, or 1,062 per week. Adding to this amount 15 per cent. for messages above twenty words, and the result would be an income of £60 12s. per week from Glasgow. The cost of the office at Glasgow, including salaries of clerk and messengers, was small, amounting to £12. It will be easily seen from this that a large margin was left to meet a dividend, and to cover any extraordinary expenses. Now, applying the shilling principle to short distances, and taking the case of Northampton, it appeared that in sixty-five days the number of messages forwarded was 454, or, allowing the addition of 15 per cent. for messages above the shilling charge, equal to a revenue of 48s. per week, but, inasmuch as the rent of the office and salaries of clerks and messengers amounted to 42s. per week, there was no profit; the balance of 6s. would not pay for current and extraordinary expenses. The importance of a low uniform charge to large places had

been proved, and what was the remedy for the state of things at Northampton? There were two courses open to them in cases of this kind; and the first they had adopted, which was the only one they could adopt. If they were to have retained the office, clerk, and messengers, they could not have taken a sufficiency to pay for dividend, and they were also certain it was the most prudent course, having reference to the experience of foreign companies, not to raise the charge. Under those circumstances they employed a tradesman in the town to do the business for the company upon commission, and he paid to the company a considerable amount of profit or balance. The other course was to carry out the work in conjunction with the other two companies; that was that one office, one clerk, and three messengers should do the work of the three companies. The first course, however, was approved and adopted. When the shareholders got no dividend on money invested in an undertaking they must naturally become dissatisfied; it was not to be supposed that shareholders would continue to supply the public with accommodation unless they got a dividend upon their capital. From the experience which had been already gained there was no doubt it would be found that the shilling scale, instead of being inadequate to pay the expenses of the undertaking, would be found not only quite sufficient for that purpose, but in time that charge, with due regard to the interests of the shareholders, might be very considerably reduced. He started with saying that he thought he had fair grounds for congratulating the shareholders on the present condition and future prospects of the company. They would shortly have a line of 9,300 miles of wire, the trunk line could be put up at a considerably diminished expense, and notwithstanding the cost of obtaining the Act of Parliament, and all the extraordinary expenses they had to encounter, they found that their property was in the most efficient and substantial condition at a moderate cost. They had their line at a less cost than that of the other two companies, and at remarkably less than the cost of the line of one of the other companies. Their line, too, was in the most effective and excellent condition, the instruments were of the most improved and satisfactory character, and the line possessed the most perfect insulation, thanks to the indefatigable exertions of their secretary and manager, to his useful inventions, and unceasing anxiety to promote the interests of the company. (Hear.) To show the efficiency of their line he might mention that one of their clerks, Miss Foster, one day lately forwarded and received 101 messages between the Stock Exchange of Manchester, and the Stock Exchange of London, in less than one hour—the whole of the work being performed with her own hands. (Hear, hear.) Under those circumstances he thought they might fairly congratulate themselves on the condition in which they were, and on the future prospects of the company. (Hear.) He needed not to detain them any longer with further observations of his own, but he should be glad to answer any questions which any shareholders might think proper to put to him. But before sitting down he should like to say a word or two respecting the two other companies. There had been differences between them; but he attributed any trouble and inconvenience that had been suffered from the other companies, not to the directors, who were not so much to blame, but to some of their officers. There had been occasions when they had had to refer to the other two companies in not very refined terms, but now they showed the most kind and considerate treatment to this company in every way. (Hear, hear.) If they could do anything to forward its interests without damaging their own, they were very glad to do it. He thought it right to make these remarks, after what might have taken place. (Hear.) He begged, in conclusion, to move that the report and accounts be received and adopted.

Lord ARTHUR CHURCHILL, M.P., seconded the motion. The chairman had gone into the most satisfactory details as to the present position and future prospects of the company, and he could only add his testimony to what really was the case, that there was every prospect of the company being, by next year, in a position to pay a very handsome dividend to the shareholders. They all knew the difficulties with which they had had to contend, and which they had happily been able to surmount. It was thought that it would be advantageous to the company to have subscribers in the country, and he was engaged with Mr. Andrews, the secretary, and others, two years ago, in travelling the country for the purpose of raising subscriptions in the various towns, and thus to make this a consumers' company. (Hear, hear.) Now they had, in the large telegraphing towns 1,143 subscribers, 1,000 of whom were resident manufacturers and persons in business who used the wires of the company in the carrying on of their business operations. That gave the company a status in the country which they should not otherwise have attained, and insured the property of the undertaking. The shilling system, which had been largely carried into practice, admitted still of very considerable increase and extension. That system had promoted telegraphy to a very great extent, not only in the business of their own company, but in the increase of the dividends other companies were likely to pay. The shilling principle admitted also of a constant growth; there was a natural increase of business from the facilities which the system afforded to all classes to send messages throughout the country. In foreign countries where a uniform rate of charge had been established the result of the system was very satisfactory. In France, for instance, the increase of messages by adopting the uniform franc system was 198,259 messages over the previous year, which likewise exhibited an increase over the year preceding. That showed that the increase was one which was constantly growing. And the system was founded on the uniform postage principle, which had succeeded so remarkably in our own country, as shown in the revenue of the Post Office department. And there was no telling to what extent the cheap telegraph system might not be carried, provided always that the line and system of telegraphy were kept in good order, so as to ensure a perfect system of communication. In his opinion their own company had got an excellent line and apparatus of the best description—apparatus of the most practical character. They had got Siemens' improved instruments, and there were other instruments of the most approved character used by the company. That being so, and their lines of telegraph having been constructed on the very best principles, there was every prospect of their being able to maintain that position which they now occupied in the telegraphic world. The directors gave every credit to their officers and clerks, who were most active and energetic in the discharge of their duties and in their endeavours to promote the interests of the shareholders of the company. (Hear, hear.) Under those circumstances there was every probability of the company proving a great success. Such being the case he had great pleasure in seconding the motion proposed by the chairman.

Mr. CREMONINI said he wished he could, like the last speaker, follow the chairman in his congratulations on the present condition of the company. He should have had a point of congratulation if the directors had shown in the statement submitted to the shareholders, a recommendation to declare a dividend. A dividend was what the shareholders looked for. It was all very well for the directors to present to the shareholders good appearances, and to talk of the future prospects of the company, but it was not so pleasant to the shareholders to have no dividend. He was totally ignorant of the deed of settlement of the company up to the present day. From his experience and connection with other companies he thought it was the duty of the shareholders to make themselves acquainted with the deed of settlement. He found by the deed of the company that the qualification of a shareholder to become a director was that he held 500 shares. Might he ask if the deed had been altered?

The CHAIRMAN.—No; the deed had not been altered.

Mr. CREMONINI then asked if each director held 500 shares of the company.

The CHAIRMAN.—There was not a director who did not hold more shares than the number requisite for qualification. He himself held more than double that number.

Mr. CREMONINI was glad to hear that. He hoped the directors would excuse him putting those questions, but he thought the shareholders ought to inform themselves respecting the affairs of the company. How many directors are there?

The CHAIRMAN.—There are eleven directors in the company.

Mr. CREMONINI was of opinion that £1,000 was a very handsome sum to be divided amongst eleven directors.

The CHAIRMAN.—The directors had reserved to themselves £1,000, but that matter was to be submitted to the shareholders.

Mr. CREMONINI.—May I ask what is the salary of the secretary?

The CHAIRMAN said the secretary did not receive so much as he was entitled to, or as he (the chairman) hoped he would receive when the company was in a more prosperous condition.

Mr. CREMONINI thought it nothing but fair that they should have information on such matters, and he thought any shareholder had a right to put such questions. As a shareholder he thought he had a right to put the questions which he had done, and he should be very happy if the shareholders could meet the directors more frequently than once a year.

The CHAIRMAN.—Before the meeting broke up it was his intention to propose that they should have a meeting every six months, and the directors expected to have to recommend a dividend at the end of the next six months.

Mr. CREMONINI.—I should like to move a resolution that we should hold the meetings half-yearly.

The CHAIRMAN would be glad to hear Mr. Cremonini propose such a resolution when the usual business of the meeting had been disposed of.

Mr. CREMONINI said he resided in a town in the heart of the iron trade containing many thousands of inhabitants; he lived at Bilston, where they had not the advantage of telegraphic communication, but it was a locality which ought to have the benefit of the telegraphic wires. Then, again, there was Wednesbury, a town of the greatest importance to the iron trade, but which, like its neighbouring town, Bilston, was without telegraphic communication. Now he thought that the town of Wednesbury, as well as Bilston should have telegraphic communication. If any of the inhabitants had to send a message to London by way of Wolverhampton or Birmingham, it cost a great deal more than it would do if there were stations at the towns he had mentioned, namely Bilston and Wednesbury. It would promote the convenience of the inhabitants, and further the interests of the company to extend their wires to these towns. He believed that their secretary, Mr. Andrews, had done all in his power to promote the welfare of the company. Whenever he (Mr. Cremonini) had written to him on business connected with the company and for information, the secretary had answered his letters promptly and in the most gentlemanly manner, and, if he found that the secretary had not a sufficient salary, when the company paid dividends he should be the first to propose that his salary should be raised. But while on this subject he would say that a great mistake had been committed, either by the secretary or the clerks, in not letting the shareholders have the report before the day of the general meeting of the company. He, like the other shareholders, came to the meeting in

ignorance, blindfolded as it were, not having had a copy of the report until he reached the place where they were assembled. Now, he said that the report ought to have been in the hands of the shareholders at least a week before the meeting, so that they might know how matters were going on, and come prepared to take part in the proceedings. (Hear.) He was a shareholder of paid-up capital in advance, and he called on the chairman to see that there was justice done. Wherever he had prepaid money he had always received interest; and unless it could be shown that this company could not make the payment, he thought he was entitled to interest on the money he had prepaid. He should, when the proper time arrived, move a resolution for holding the general meetings of the company half-yearly, so that the shareholders might have information concerning their property as soon as possible. He wished to say that though desirous of obtaining information by the questions he put, he had no hostile feeling in doing so, but on the contrary he should do all in his power to promote the interests of the company. (Hear, hear.)

The CHAIRMAN said the directors had not overlooked or forgotten the towns of Bilston and Wednesbury, which they looked upon as being likely to prove important telegraphing places, but they were in the habit of first asking for subscribers in the towns in the country to be embraced in their telegraphic communication, giving the subscribers stamped bonds, bearing 7½ per cent. interest, and the directors would, in the usual way, ask the inhabitants of Bilston and Wednesbury for subscriptions. The system of getting subscriptions formed an intimate connection between the towns and the company; it made the towns tied to them, and that had been a great strength of the company hitherto. As regarded the general meetings and the sending out of the report to the shareholders some days before the meetings were held, hitherto a difficulty had been experienced in getting the report ready in time to be so sent out. According to their deed the general meeting must be held in July, the accounts were made up to the end of June, and looking at the extensive ramifications of the company there was considerable difficulty in getting all the accounts prepared and made up in time, but when they had half-yearly meetings they should have time for the preparation of the financial statement to be laid before the shareholders, and there would be time to send out the report to the shareholders a week or so before the day of the meeting. As regarded the claim made by Mr. Cremonini, for interest on prepaid money, he thought they must decide against him for the present. The shares which that gentleman possessed were shares paid in part payment for work done by some of the contractors, to bear dividend along with the shares of the company, so that the money advanced was not advanced with the condition that it should bear immediate interest. A portion of work done was paid for so much in money and so much in shares, to bear dividend when dividends were declared. But they could not pay dividend upon those shares until a dividend was declared amongst the whole of the shareholders. However the question would be submitted to the solicitor of the company for his opinion.

Mr. CREMONINI.—If the directors issued those shares in exchange for work done for the company, he bought the shares with their sanction, and they admitted him a shareholder. And he applied for interest on prepaid money, which he said he was entitled to. If they issued shares to parties that were doing contract work for them, they ought to have pledged them not to part with those shares until such a time as dividends were paid. But if they consented to take the transfer, he said he had a just claim to demand interest on the prepaid capital; he had a right to be paid interest.

The SOLICITOR to the Company.—Under what document do you make a claim for dividend?

Mr. CREMONINI.—I claim a dividend, you admitting me as a shareholder of paid-up capital.

The SOLICITOR wished to know under what document Mr. Cremonini claimed. Unless he had a preferable claim it would not be just for the directors to pay him dividend, and not the other shareholders?

Mr. CREMONINI said he claimed because he was a shareholder of prepaid capital.

The CHAIRMAN.—The question will be submitted to the solicitor for consideration.

Mr. CREMONINI remarked, in reference to the obtaining of subscriptions in the two towns to which he had referred, that if they were to solicit subscriptions at Bilston and Wednesbury, he questioned if they would succeed, for they were near one of the townships already. But he was sure the feeling of the inhabitants was in favour of giving the business to the United Kingdom Company in preference to any other company, because it was the first to reduce the charge of messages.

The CHAIRMAN said the requisite inquiries and investigations would be made at Bilston and Wednesbury respecting the establishment of telegraphic communication at those places. The claim set up for interest by Mr. Cremonini would also be inquired into.

Mr. GORING saw that there was a large item put down for law expenses. Then there was the case of Allan—how was that settled?

The CHAIRMAN said they had had very little law expense; he supposed that £50 would pay the whole of such expenses during the last half-year.

The SOLICITOR.—Half of that sum.

The CHAIRMAN.—They had not been expensive under the head of law charges. He thought there was nothing more to be avoided than a law bill, and they had not had much outlay on law. As to the case of Mr. Allan, the amount was incurred the previous half-year. Mr. Allan, who was formerly the electrician of the company, brought an action against them. The company thought that Mr. Allan had not the slightest claim morally upon them, and that he had not the thousandth part of the scintilla of a claim legally upon them. And Mr. Allan having thwarted them in every way, and given them great annoyance, the directors came to the conclusion that the claim he set up was one which they should resist to the utmost, and were prepared to do so. But on the very morning of the trial Mr. Allan's own counsel went before the judge, said he thought he had no case, and withdrew the record. Though the company were put to an expense in preparing for that trial, they had a claim for the recovery of the whole of it upon Mr. Allan.

In answer to Mr. GORING, who drew attention to the matter,

The CHAIRMAN said that there were certain items entered under the law charges which ought not strictly to come under that head. That would be avoided in future.

A SHAREHOLDER said he thought it was premature for the directors to reserve for themselves £1,000 at the present time.

The CHAIRMAN.—We will submit the matter to the shareholders at the end of the next six months, if you like.

A SHAREHOLDER.—I suppose that this is the proper time, as it is remuneration for the past twelve months.

The CHAIRMAN.—Well, we have not taken it yet, I can tell you.

A SHAREHOLDER.—But if we pass the report and accounts it will give you power to do so.

The CHAIRMAN said the directors would pledge themselves to the next meeting not to appropriate anything to themselves until they had submitted the subject to the shareholders.

Captain WASEY inquired what position this company held in reference to Bonelli's opposing line at Manchester, which was conducted on the sixpenny principle?

The CHAIRMAN said that that line was given up at the present time.

In answer to a question by Mr. CREMONINI,

The CHAIRMAN said the directors had taken during a portion of the time of the operations of the company the amount allowed by the deed of settlement, and they thought they were entitled to it. The directors held close upon 1,200 shares each in the company, the whole of them were paid-up, they had received no interest, and were a considerable amount out of pocket in travelling expenses; so that they had, up to the present time, acted according to the deed of settlement. But the directors had come to the resolution not to take the proposed remuneration of £1,000 until the subject was submitted for approval to the shareholders.

Mr. CREMONINI was very glad to hear that the directors had such a large interest at stake in the company, and he hoped the anticipations which their worthy chairman had expressed that day would be fully realised. He was very glad the chairman coincided with him as to the propriety of holding half-yearly meetings, a subject upon which he should presently propose a resolution.

The CHAIRMAN then put to the meeting the motion that the report and accounts be received and adopted, and it was unanimously agreed to.

The CHAIRMAN then moved the second resolution:—"That James Nugent Daniell, Esq., Edward W. H. Schenley, Esq., and George Virtue, Esq., be re-elected directors of this company."

Mr. ROBINSON seconded the motion, which was carried *nem. con.*

The CHAIRMAN moved the next resolution:—"That Percy Stace, Esq., and Theodore B. Jones, Esq., be re-elected auditors of the company."

Mr. GORING seconded the motion, which was unanimously agreed to.

Mr. CREMONINI then moved:—"That in future the general meetings of the company be held half-yearly, instead of yearly." He hoped, and had no doubt, that the proposed change would have a beneficial effect, inasmuch as each shareholder would take greater interest in what was being done by the company. He thought that their company was now one of some importance, and that the shareholders ought to meet oftener than at present, so that they might receive accounts respecting the state of the company, and what were its operations and success. He hoped sincerely that the anticipations uttered by the chairman would be fully realised, and begged to move that the meetings of the company be held half-yearly instead of yearly.

Mr. EDWARD W. H. SCHENLEY seconded the motion.

The CHAIRMAN said it might not be quite regular to call the meeting a half-yearly one, but it could be called a general or extraordinary meeting of the shareholders of the company, or something of that kind. In this way the shareholders might be called together within seven months of the present time, and he hoped they might then be in a position to declare a dividend. The directors would also make arrangements, so that the report and statement of accounts should be forwarded to the shareholders as many days before the meeting as possible.

Mr. CREMONINI's motion was then passed unanimously.

The CHAIRMAN said he had to move a vote of thanks to their very talented and able secretary and manager, Mr. Andrews. From what had already taken place there could be no doubt of the success of this company; and when it became an established fact, with payment of 10 per cent. dividend, as well as the apportioning of back dividends on paid-up money, they should keep in mind at that time the gentleman who had done so much for them (Mr. Andrews), and take care that at that time there should be some acknowledgment of his superior merit and extraordinary talents. He had much pleasure in proposing a vote of thanks to Mr. Andrews, the secretary and manager.

MR. CREMONINI had much pleasure in seconding the resolution. Of course in any new undertaking the responsibility rested mostly on the officers of the company who had the principal management. We live in a wonderful age, and the electric telegraph aimed at, and undoubtedly had already achieved, great things, though still greater would, there was no question, yet be accomplished. He had noticed that their worthy secretary was a gentleman well qualified to manage the affairs of the company, and he did hope for his honour and credit's sake that the remarks of the chairman would be realised. At the same time he was not so sanguine as to expect a 10 per cent. dividend at once; he would rather hold up his hand for a 5 per cent. dividend to begin with. If they could pay their way—if they maintained a solvent and independent position before the public—the public would support them, and they should be able to show to the public that they were at least equal to any other company.

The motion was carried amidst applause.

Mr. ANDREWS, the secretary, thanked the meeting for the very kind and flattering vote of thanks which had just been passed. That vote could not be meant for himself only, but to include all the other officers of the company, who all co-operated to the greatest extent. They had not only worked hard and done their duty, but they had done more than their duty, and had worked with the greatest enthusiasm for the company. More especially was this the case with their engineer, Mr. Powell, who had laboured night and day, and done his work in an excellent and efficient manner, and generally speaking the directors and shareholders had reason to be satisfied with the exertions of their officers. He had, therefore, to thank them, not so much for a vote of thanks to himself, but to him as the representative of the officers of the company in general, in which form he had very great pleasure in receiving and thanking them for the compliment.

Mr. HOOD moved a vote of thanks to the chairman and directors generally.

The motion was seconded and carried by acclamation.

The CHAIRMAN acknowledged the compliment.

The meeting then broke up.

REPORT OF THE DIRECTORS OF THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.

THE prosperous condition of the country has caused great activity in every branch of the Company's operations during the half-year.

Notwithstanding the numerous local reductions in rates which have been made from time to time, the internal receipts have increased, and the new circuits and stations which have been opened have contributed to this result; but the large addition to the revenue which has accrued during the last six months is mainly due to the great expansion of the Continental traffic arising from the constantly widening area of the telegraphic field throughout Europe.

The gross income of the Company for the half-year ending 30th June, 1864, amounts to £136,473, and is in excess of that for the corresponding period of 1863 by the sum of £19,263.

The working charges incurred in earning this revenue, including the interest of the debenture debt, and the sum voted by the general meeting to the late secretary, amounts to £87,643, or £9,495 more than in June, 1863. There is consequently an increased profit over the return of that period of £9,679, and the net income of the half-year, after making every provision, amounts to £48,830.

The proprietors may reasonably expect to participate in the success which, from the causes assigned above, has attended the undertaking; and having due regard to their established policy of applying a fair portion of the earnings to the reserve fund, the directors feel warranted on the present occasion in recommending a dividend of £4 per cent. for the half-year on the stock, and on the new shares £5 paid up. This appropriation will absorb £38,995, and leave a balance of £9,835 to be carried to the trust fund.

This fund, with its accumulated interest, now amounts to £29,188 4s. 3d., and the above addition will increase it to £39,023 6s. 9d.

The Electrician's report appended hereto will satisfy the shareholders that no relaxation has taken place in the directors' determination to maintain every portion of the system in the highest state of efficiency. They are daily more impressed with the necessity of attending carefully to this essential condition of the Company's well-being. Surrounded as they are by new candidates for the public favour, they can only retain and extend the public confidence by performing the service in the most complete, accurate, and rapid manner of which the telegraph is capable; and every invention having this object is examined by them with a view to its practical application, if it affords reasonable ground for expecting an improvement. The accounts which they have now the pleasure of submitting afford some evidence that the public, by their continued and increasing support, appreciates the efforts made to maintain a superiority over their rivals.

Following the course which for many years they have steadily pursued, the directors have made a variety of modifications in their tariff during the half-year, as they found that they could do so with a fair regard to the interests of the shareholders; and although the first result of all such reductions is necessarily to check the receipts and increase the working charges, the board is strongly impressed with the conviction that a judicious periodical revision, as circumstances permit it, must, by associating the public to some extent in the success of the undertaking, contribute to the permanent prosperity of the Company.

ROBERT GRIMSTON, Chairman.

Report of Mr. Cromwell F. Varley, Electrician to the Company.

Gentlemen,—I have much pleasure in stating that your circuits continue in the same excellent order as mentioned in my last report.

The two wires in the Lowestoft-Zandvoort cable, which were injured during the heavy gales in December last, were successfully repaired on the 28th March. Your other cables have worked without any interruption during the past six months, and their insulation remains unimpaired.

The additional wires connecting London with Manchester, Derby, Leeds, Newcastle, and Edinburgh, and the new wire between Edinburgh, Dundee, and Montrose, have been completed, and are now in full and efficient operation. An additional wire has also been erected between London and Epsom.

The renewal of your line on the west coast, between Glasgow and Lockerbie, is rapidly progressing, and will shortly be completed; and at various other places, where weakness had become apparent, the lines are being renewed in the most approved manner.

The last section of your underground wires between London, Manchester, and Liverpool, viz., between Colwich and Rugby, is almost entirely replaced by overground wires, and before autumn sets in this communication will be equal to any in Great Britain.

In June the new pneumatic system was completed and put into operation between the various stations in Liverpool. This is working in the most satisfactory manner.

The new central station in Manchester has been opened, and is in full work. The construction of the pneumatic system to connect it with the branch offices is progressing rapidly.

In addition to the works mentioned above, the following have been completed during the present half-year:—The erection of the telegraph on the Broughton and Peebles branch of the Caledonian Railway, on the Gosport and Stokes Bay line, and on the Merthyr, Tredegar, and Abergavenny Railway, between Brynmawr and Tredegar. An additional commercial wire has also been completed between Plymouth and Truro, and between Falmouth and Penryn.

The following works are in progress:—The erection of an additional wire for commercial purposes between Liverpool and Glasgow. The erection of the telegraph on the following lines:—The Hertford, Luton, and Dunstable Railway, the South Leicestershire Railway, the Farringdon Railway, the Isle of Wight Railway, the Inverness and Ross-shire Extension Railway; the Eccles and Wigan line of the London and North Western Railway, and the erection of additional wires for train signals on the most important sections of the same railway.

The figures below show the increase of your system:—

	Dec. 1863.	June, 1864.	Increase.
Miles of line	8,230	8,548	318
Miles of wire	39,042	40,074	1,032
No. of Instruments	4,489	4,703	214

BALANCE-SHEET OF THE COMPANY FOR THE HALF-YEAR ENDING 30TH JUNE, 1864.

Dr.

	£	s.	d.	£	s.	d.
Consolidated Stock	899,875	0	0			
15,000 New £10 Shares (£5 paid)..	75,000	0	0			
				974,875	0	0
Debenture Debt............				80,550	0	0
Fire Insurance Fund				470	7	3
Balances due to sundry creditors				23,127	15	5
Undivided profit 31st Dec., 1863, less carried to Trust Account				6,362	0	2
TRUST ACCOUNT.						
Balance 31st Dec., 1863..	12,368	1	9			
Surplus, 31st Dec., 1863..	16,447	17	10			
Interest	372	4	8			
				29,188	4	3
Balance of Revenue Account as under				48,830	2	6
				£1,163,403	9	7

Cr.

	£	s.	d
Total cost of the construction of the Electric & International Telegraph	964,510	10	6
Channel Islands Telegraph..	4,200	0	0
New Central Station and Camden Stores	25,748	8	9
Balances due from sundry debtors	79,588	9	8
Value of stores	44,858	8	4
Securities in hand..........	3,043	3	6
Trust Account agreed to at the half-yearly meeting, 31st July, 1858	29,188	4	3
Balance at the Bankers	12,266	4	7
	£1,163,403	9	7

Revenue Account.

				£	s.	d.	£	s.	d.
Receipts for messages, subscriptions, intelligence, maintenance contracts, interest, and transfer fees				141,191	0	6			
Less porterage paid out				4,717	4	4			
							136,478	16	2
Salaries and wages				36,450	8	5			
Station expenses				3,614	19	4			
Rent, taxes, gas, and insurance				7,645	2	7			
Books, stationery, and printing				3,529	10	2			
Postage				200	4	8			
Newspapers, lists, and reports				78	11	4			
Law charges				831	18	6			
Continental agency				1,479	13	8			
Direction and audit				1,250	0	0			
Maintenance, labour	10,725	6	1						
" materials........................	17,128	19	10						
				27,854	5	11			
Contributions to Sickness Fund				94	1	6			
Cost of repairing submarine cables				1,640	18	7			
				84,669	14	8			
Interest on debenture debt	1,778	16	0						
Interest on loans	200	3	0						
				1,978	19	0			
				86,648	13	8			
J. S. Fourdrinier (late Secretary), voted at half-yearly meeting				1,000	0	0	87,648	13	8
							£48,830	2	6

Examined and found correct,

30th July, 1864.

JAS. ROLLS,
CHAS. PRESSLY, } Auditors.

General Balance.

	£	s.	d.		£	s.	d.
Dividend on £899,875 Consolidated Stock, at £4 per cent., for the half-year ending 30th June, 1864 ..	35,995	0	0	Balance after payment of dividend, 31st Dec., 1863..£22,809 18 0			
Dividend on 15,000 £10 shares (£5 paid), at 4s. per share (£4 per cent.) for the half-year ending 30th June, 1864..........	3,000	0	0	Carried to Trust Account.... 16,447 17 10	6,362	0	2
Undivided profits to 31st Dec., 1863 ....£6,362 0 2				Balance of Revenue Account, 30th June, 1864	48,830	2	6
Balance after payment of dividend.......... 9,835 2 6							
	16,197	2	8				
	£55,192	2	8		£55,192	2	8

Investment of Trust Fund.

	£	s.	d.
Cash on deposit	28,500	0	0
Balance in cash	688	4	3
	£29,188	4	3

30th July, 1864.

ROBERT GRIMSTON, Chairman.
H. WEAVER, Secretary.

HALF-YEARLY MEETING OF THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.

On Wednesday afternooon the thirty-seventh half-yearly ordinary general meeting of the proprietors of this company was held at the company's offices, Telegraph-street, Moorgate-street, to receive the directors' report and statement of accounts, and for the transaction of the ordinary business of the company. At the close of the ordinary meeting a special general meeting was held for the purpose of considering and determining on the claims of Mr. Fourdrinier, the late secretary, to a further grant of money in addition to that voted at the last half-yearly meeting.

The following directors were present:—The Hon. Robert Grimston, chairman; Mark Huish, Esq., W. F. Cooke, Esq., Frederick N. Micklethwaite, Esq., W. H. Smith, Jun., Esq., and Richard Till, Esq.

The chair was occupied by the Hon. Robert Grimston, chairman of the company.

The Chairman, in opening the proceedings, called on the secretary to read the advertisement by which the meeting was convened.

Mr. Weaver, the secretary, accordingly read the advertisement.

The Chairman said he had to affix the seal of the company to the register of shareholders.

The seal having been affixed,

The Chairman said it was usual to take the report, which was in the hands of the shareholders, as read; would they now have it read by the secretary, or take it as read in the usual course?

The meeting decided to take the report as read.

The Chairman said he need hardly remind gentlemen present of the policy which had been pursued by this company for nearly seven years. Instead of striving after high dividends they had rather tried to strengthen the position and consolidate the property of the company, and in so doing they had from time to time been enabled to make numerous improvements and even additions to the property, and in their turn those improvements and additions had added to their revenue, so that during the period he spoke of—about six years and a half—their income had increased £96,000 a-year. In fact, the whole system worked in a circle. The more money they spent upon their lines the more money their lines would earn. For instance, if they took the cable that they last laid to the Continent, the cost of that cable was borne entirely out of revenue, and that cable every half-year brought back in revenue somewhere about 25 per cent. of its original cost. Now he could well understand many sensible persons would say that, with a policy that had succeeded so well, why should they not be content?—why should they not leave well alone? But there must be bounds even to prudence; there must be some limit; there must be moderation even in moderation itself. (Hear, hear.) And even if they were desirous of doing so, they could not gainsay those figures which had been presented to them. They had not neglected the maintenance of their property; but, on the contrary, they had maintained all their lines in the most efficient condition; they had proposed to lay by a sufficient sum for reserve, and yet there remained out of the net earnings for the half-year a sum more than sufficient to pay the dividend they had been accustomed to receive. That money belonged to them—to the shareholders—and the directors proposed to divide it, and that they raise the dividend from 3½ per cent. to 4 per cent. for the half-year. (Hear.) Now, he trusted that gentlemen would look at this in a business-like manner, and that they would not think that this was their fixed income. They must recollect that dividends depended upon rates, and that rates depended upon circumstances—upon circumstances over which no mortal had ever control. And he hoped that the shareholders would look upon the income of the past half-year as an exceptional income—in fact, as a sort of bonus they had received at the termination of an unusually prosperous half-year. The accounts spoke pretty plainly for themselves. On one side were increased rates, and on the other side were expenses attendant upon earning those rates, which are also necessarily increased. The percentage of rates was largely reduced; it was reduced nearly 3½ per cent., and certainly with an increased traffic a reduction ought always to be a matter of course. But it was not quite a matter of course when they came to consider that they had reduced their tariff to nearly every principal place in this kingdom. Some of those reductions had been forced upon them; for instance, they carried a message from London to Glasgow, a distance of 400 miles, for 1s. Now that was absurd. But other reductions had been made voluntarily, and they had to be well weighed and thoroughly considered by the board of directors; and he had no hesitation in saying that all those well-weighed and thoroughly-considered reductions would ultimately prove most beneficial to the company. (Hear.) There was a question he should have to say a few words upon hereafter, and that was with respect to the claims made upon the company by Mr. Fourdrinier, their late secretary. Notice had been given that at the close of the present meeting a special meeting would be held for the purpose of considering those claims, and then he should have an opportunity of saying a few words on the subject. He had now great pleasure in moving that the report and accounts be received and adopted.

Mr. Mark Huish, deputy chairman of the company, had great pleasure in seconding the motion.

The Chairman put the motion to the meeting, and it was carried unanimously.

The Chairman moved that a dividend at the rate of 4 per cent. for the half year ending 30th June, be declared on stock, and on the new shares, five pounds paid up, to be paid out of the profits of the company.

Mr. Mark Huish seconded the motion with great pleasure.

The Chairman put the resolution, and it was passed *nem. con.*

This concluded the business of the ordinary general half-yearly meeting.

The meeting then resolved itself into a

SPECIAL GENERAL MEETING.

The Case of Mr. Fourdrinier.

This meeting was held for the purpose of considering and determining on the claims of Mr. Fourdrinier, the late secretary, to a further grant of money, in addition to that voted at the last half-yearly meeting.

The Chairman said, during the time he had had the honour of a seat at the board of directors, what with an indulgent proprietary and a united board, and generally pretty prosperous seasons, he allowed that he had had a great deal of pleasure in assisting in carrying on the affairs of this company. He did not say that occasionally circumstances had not arisen to vex or annoy one; but still, upon the whole, the smooth had very much predominated over the rough. (Hear, hear.) However, at their last half-yearly meeting a circumstance arose which gave considerable annoyance to his brother directors and himself. As the affairs of the company had increased to such an extent—they had increased to such an extent as to go beyond the powers and scope of the gentleman who had been in their service as secretary for fifteen years (Mr. Fourdrinier)—the board felt that they required a younger man, and the infusion of fresh blood into the company; and accordingly they appointed Mr. Weaver their secretary in the room of Mr. Fourdrinier. That was a step which he was quite sure all the shareholders and the board of directors had reason to congratulate themselves upon, for it had been a most successful step. (Hear, hear.) But still, at the same time, in getting rid of one servant and installing another in his place, the board thought they should only be doing an act of justice

and policy in giving the former some remuneration for his past services. The last half-yearly meeting was but very thinly attended indeed, and some opposition arose on the part of some of the shareholders to the proposition of the board. And though it was in the power of the directors with their own personal votes, to carry the motion they had proposed, they did not, however, intend to use the proxies which were entrusted to them by a number of shareholders, though it was in the power of the directors, by their own personal votes, to carry their proposition; they, however, thought it more decorous to bow to the decision of the meeting, and they did so. At the last meeting the resolution agreed to was, that the sum of £1,000 should be awarded to Mr. Fourdrinier. Now, when he told them that Mr. Fourdrinier could have claimed from the company a year's salary of £750, it would be seen that the vote of £1,000, come to at the last meeting, actually gave to their late secretary only £250. (Cheers.) And that remuneration was at the end of fifteen years' faithful and upright service, and those years the best years of the gentleman's life. Surely it was not to be wondered at that the gentleman should say that that provision was one that was inadequate. But after the meeting he (the chairman) found that the resolution awarding Mr. Fourdrinier £1,000 did not give satisfaction. It was not satisfactory to a number of the proprietors, who said they did not approve of it, and thought that it was unworthy of a great company. (Hear, hear.) They also said that the motion was carried by surprise.

A SHAREHOLDER—No, no. (Cries of "Yes," and "Order.")

The CHAIRMAN (in continuation)—He was only telling them what was told him, and he might have put it in stronger language. They said that the motion was a very unsatisfactory one, that it had been carried by surprise, and that the directors should have given notice to the shareholders that the subject was to be considered at the meeting. And accordingly the directors had given due notice that the subject would be brought before the present meeting, so that gentlemen if they thought fit might come forward and express their opinion upon it. (Hear, hear.) And in order to put the question into shape, he now moved that the sum of £1,000 be paid to Mr. Fourdrinier, in addition to the sum voted at the last half-yearly meeting.

Mr. W. F. COOKE said, although he had not been called upon, he had great pleasure in seconding the motion proposed by the chairman. Mr. Fourdrinier was a most faithful and upright officer of the company, to which he had remained constant under circumstances of great temptation. During the time he was their secretary other companies were springing up, and they tempted the officers of this company to leave by offering higher sums as salaries. Considerable advances on their salaries were offered to them to join other companies, and, although they were receiving good salaries, with the prospect of an increase, yet some were fairly tempted away from them. But notwithstanding the temptations held out, Mr. Fourdrinier was always firm and staunch to the company; he did not think that anything would have drawn him away from them. His (Mr. Cooke's) belief was that Mr. Fourdrinier was a really honest, upright, and conscientious man. (Hear, hear.) He was a faithful servant to the company, to which he devoted his time. He did not raise the question of his talents, about which, perhaps, a difference of opinion might exist; but he spoke of his staunchness and fidelity to the company. In the midst of temptations to withdraw him from them, he stuck to the company. He hoped there were others who, like him, would be faithful to the company. He had much pleasure in seconding the motion of the chairman, which, in an exceptional and highly-deserving case like the present, ought to be carried. Mr. Fourdrinier entered their employment when somewhat advanced in life, and might fairly be expected to retire after serving fifteen or twenty years. It was found that as their business increased so much they should have younger men in their offices, and Mr. Fourdrinier retired without making any obstacle to the arrangements proposed to be carried out by the board. The chairman had spoken of Mr. Fourdrinier in a favourable manner, and their late chairman, Mr. Stephenson, had he been present, would have done the same; and so also would another chairman, had he been here, he meant Mr. Ricardo, who might be considered the founder, the great manager, and the man who, for years, gave life and energy to the company. If they would allow him, he would read some extracts from a letter of Mr. Ricardo, in which he referred to the character and services of Mr. Fourdrinier. The extracts were as follows:—"I cannot consider myself fairly out of the wood till a permanent chairman is appointed, but my emancipation from the labour and anxiety of the thankless office I have held for ten years does seem possible, notwithstanding the difficulty to enable me disentangling myself from this thing. It is, however, impossible that I can leave the chair of the Electric Telegraph Company without a most full and ample acknowledgment of the great assistance that I have received from you in the administration of the affairs of the company. The industry, perseverance, and talent which you have shown on every occasion, in which such qualities are demanded, have relieved me of such a load of anxiety and perplexity, as it would have been difficult for me to support, while the complete and unrestricted confidence which I reposed in your integrity enabled me cheerfully to accept any financial responsibility which fell upon me, and I feel the assurance that my honour and reputation are safe in your hands. I have to thank you for many valuable suggestions for the more efficient organization of all the departments under your control, and for the prompt and efficacious manner in which you willingly carried out my views and projects, and also for on many occasions showing me their inutility or impracticability. It is not the way of the world, nor do I expect that any exertion of yours or mine in a public capacity should be acknowledged or appreciated, but I think we shall always have some satisfaction in the associations connected with the difficulties we have encountered together, and, I may say, overcome together. And I, for my part, shall always take an interest in the prosperity of the undertaking, and my advice or assistance will always be at your command. I cannot conceal from myself that in the performance of my duty I have been compelled to make some enemies, but I hope that I have made many more friends, and amongst them all believe me that there is not one whom I value and respect, and whose regard I desire to retain more than yourself." Such were the sentiments of Mr. Ricardo. (Hear.) From the feeling that was expressed by the meeting before he ventured on reading the letter—it was almost unnecessary for him to do so; but he thought it was only an act of justice to Mr. Fourdrinier that it should be read (hear), and also an act of justice to Mr. Ricardo, to show that that gentlemen was always ready to acknowledge the labours of those who assisted him in carrying out his projects for the extension of telegraphic communication. Before sitting down he had much pleasure in seconding the motion of the chairman.

Mr. J. W. FRASER inquired how it was that the sum of £750 was due to Mr. Fourdrinier?

The CHAIRMAN.—He had a right to claim a year's salary of £750.

Mr. FRASER.—Had he not notice?

The CHAIRMAN.—No; he was discharged under peculiar circumstances.

Mr. FRASER only made these remarks because the chairman said £750 were due to Mr. Fourdrinier, and he was wondering how it was that sum was not paid.

The CHAIRMAN.—Under the circumstances of his leaving, a year's salary was due to him, but as the company chose to give him £1,000, Mr. Fourdrinier made no claim for the £750; so that in point of fact the company had really only given him £250. The whole of the circumstances connected with Mr. Fourdrinier's leaving the service of the company he could explain, but he did not think it was necessary to do so.

Mr. FRASER remarked that the first proposition made at the last meeting was to pension their late secretary, but that was objected to, as establishing a bad precedent. In the course of some further remarks Mr. Fraser was understood to object to the principle involved in the motion before the meeting, though he had no particular feeling in reference to this case.

A SHAREHOLDER thought that the sum of £1,000 ought to be given to Mr. Fourdrinier.

Mr. KIMBER said no doubt Mr. Fourdrinier had assisted Mr. Ricardo in the services he had rendered to the company. He believed that the question to be considered was not whether Mr. Fourdrinier was a good servant while in the employment of the company, and not whether he should be well paid for his work, because he had been paid, but the question was whether, after his services had been terminated by the board on behalf of the company, the company should be called upon to vote this £1,000 without any consideration —whether they were entitled to pay away this money which belonged to the whole of the shareholders. Now, he did enter his protest against such a proceeding. He did not wish to see any one underpaid for his services— he had had too many under him for years not to know that it was a good policy to pay servants well—but on behalf of the shareholders, though his own interest in the company was not so large as to make it a matter of importance to him, he protested against the motion. His opinion was that to carry the motion into effect was *ultra vires* of the board, and he therefore entered his protest against it. At the last meeting it was objected to the proposition then made that no notice of it had been given. Now that omission had been rectified. At the last meeting the sum of £1,000 was voted to Mr. Fourdrinier in lieu of a pension, which was considered objectionable in principle. The question was had they the power, after the termination of the services of their late secretary, to vote money to him? Now, he said they had no such power, and that if there was only a minority of one against it, it was in the power of that shareholder to take proceedings against the directors for assuming that they had authority to do so. He did not wish the company or the directors to get into difficulty. He did not raise this difficulty without due consideration, and in his opinion it was well founded. A word as to the £750 which it was said Mr. Fourdrinier might have claimed from the company. No doubt that gentleman might have claimed a year's salary if he was discharged from the service of the company without notice. But why did not the board retain Mr. Fourdrinier's services for the year; they might have retained them *quantum valeant*—they might have furnished him with something to do for the £750. He did not wish to pump the directors for the reasons why they discharged, without notice, Mr. Fourdrinier, and engaged another gentleman in his place; but he did not see why, after paying their late secretary £750 a-year, they should be called upon to give him £1,000. The directors might commit errors in judgment, but he did ask them to pause before entering on a course which would lead to great irregularities and illegalities.

Mr. GLASS thought this matter involved a very serious question. The shareholders left their property in the hands of the board, and he thought that from the report placed before them that day they must all come to the conclusion that their property had been thoroughly well managed. (Hear, hear.) And if any individual shareholder was to be at liberty to interfere with the board as to the way in which servants were dismissed or taken on, he thought the sooner the shareholders took charge of the business the better. (Hear, hear.) He did not inquire why Mr. Fourdrinier was dismissed; he presumed that there was good reason for it. He did not inquire

why he did not receive notice; he presumed that there was good reason for it. Mr. Weaver has been appointed secretary, and that appointment has given universal satisfaction. (Hear, hear.) He knew that he spoke the opinion of a great many when he said that the course proposed to be taken in reference to Mr. Fourdrinier was a correct one, and he was prepared to support the directors. He hoped that shareholders would consider the effect, the serious effect, of interfering with the directors in the steps they had taken. If their decisions were to be constantly subject to the approval of a general meeting of the shareholders, he thought their position would be anything but agreeable and pleasant. (Hear.)

Mr. Bocknell.—Is there any understanding of a pension or allowance beyond this £1,000?

The Chairman.—No, nothing beyond this £1,000.

Mr. Bocknell.—After a man had served the company so long and so well, after the testimony which had been borne to his character by the well-qualified dead, as well as the living, he thought they should not do otherwise than pay him well, and they ought not captiously to call in question the conduct of the men who were doing their best for them—the directors. (Hear, hear.) See how they were getting on, and look at other companies! They had directors who were willing to do all for them, and to serve the company in the best possible manner. Their late secretary was a useful and very worthy and efficient man, and he really did say that if a man had for fourteen or fifteen years served well in a high position, and had got the confidence of the directors and the company, perhaps £1,000 was really nothing more than what was due; and he hoped the little captious feeling in opposition to the directors would be put aside, and that they should, hearts and hands together, carry the motion.

Mr. Reid.—If this Mr. Fourdrinier was such an efficient and worthy servant, why was he discharged?

A Director.—He was not discharged, Mr. Reid.

Mr. Reid.—He was fifteen years in the company's service, but why should a man leave the company's service in the prime of life, when he might live other twenty years or more? Why should the directors discharge him, or order him to send in his resignation, because he believed that was the form of it, to make room for another? If that was the case, it would seem that the directors wished to get rid of the man, but had not courage enough to discharge him, and it was proposed that he should be pensioned for life. Perhaps the chairman could give them some information on the subject.

A Shareholder.—What is £1,000 to the company?

Mr. Reid was not saying anything about that. As to the letter which had been read, it was a letter by the dead bearing testimony to the character of the living; but he should be sorry to differ with Mr. Cooke upon the point of the propriety of reading that letter. Mr. Fourdrinier was incapable of conducting negotiations for the company; he was only fit to open letters. He would remind the meeting, moreover, that Mr. Fourdrinier came to the company in a state of semi-starvation. (Cries of "Shame, shame," "Stick to the point," and loud hissing.) It was the truth notwithstanding.

Mr. Cooke.—Perhaps you speak relatively; he was not in a state of semi-starvation.

Mr. Reid said the question he wished to get answered was, why was Mr. Fourdrinier requested to send in his resignation?

The Chairman.—Have you finished, Mr. Reid?

Mr. Reid.—For the present.

The Chairman.—You had better finish your address now.

Mr. Reid.—Oh, I have done.

The Chairman said in this matter the directors had taken the course which they considered best for the interests of the company. (Hear.) They had referred to their legal advisers, and it was found that the company had full power to do that which was now proposed by the motion before the meeting, and due notice had been given to the whole of the proprietors, so that it was in the power of every shareholder to attend the meeting, and express his opinion on the subject. He did hope that the gentleman who last addressed the meeting (Mr. Reid) had expended his venom at the last meeting against an inoffensive and faithful servant. (Hear.) He (Mr. Reid) read from a paper on that occasion certain matters that took place about fifteen years ago—long before he (the chairman) was a shareholder in this company, and long, probably, before many of them were shareholders; and after the meeting he (the chairman) made it his business to search into the archives of the company.

Mr. Reid rose to order. (Cries of "Oh, oh," "Chair, chair," "Order order.")

The Chairman, in continuation, insisted upon being heard. He was going to show the animus of that gentleman (Mr. Reid) against Mr. Fourdrinier, and he found from the minutes of the board why and wherefore he had such a feeling against Mr. Fourdrinier. (Hear, hear.) In the early days of the company the honourable proprietor (Mr. Reid) contracted to maintain the lines of this company. There were constant complaints made day after day that the lines were not properly maintained, and those unpleasant communications had to be made by Mr. Fourdrinier to the honourable proprietor. Now, the honourable proprietor so far neglected his duty that the board took the maintenance of the lines out of his hands, and he thereupon claimed several thousand pounds from the company. The board declined to pay him this money, and he thereupon commenced an action against the company. The company paid into court fewer hundreds than the honourable proprietor had claimed thousands, but he took the money out of court, and he dropped his action. (Laughter.) Now, the honourable proprietor at the last meeting stated that he prevented the company being robbed. He (the chairman) did not like the word "robbed," but that was the way in which he treated the company. Now, he thought the honourable proprietor ought to recollect that a man who lived in a glass-house should not be the first to throw stones. (Hear, hear.)

Mr. Fraser asked how it was, after the decision of the last meeting, that this question came up again. Many were under the impression that by the vote of the last meeting the question was settled.

The Chairman said the question had been brought before the meeting again at the request of several shareholders, and, amongst others, some of the largest shareholders of the Company; and, in fact, he had had an enormous number of proxies sent up to him for the purpose of being used at the meeting if necessary.

A Shareholder.—After the allegation which had been made by one of the speakers (Mr. Reid), that Mr. Fourdrinier was only fit to open letters, and incapable of conducting negotiations for the company, he said his experience proved that the contrary was the fact. Through the tact of Mr. Fourdrinier the company secured possession of a house, in which he (a shareholder) was interested, for a sum three hundred pounds less than he (a shareholder) thought they ought to have done; so that their late secretary, in this transaction, had, if he had injured him, done the company good service.

Mr. Reid said after the long story told by the chairman about something or other, he insisted on again putting the question he had done, but was called to order.

Mr. Reid said he wished to know why Mr. Fourdrinier was discharged?

The Chairman said he would give an answer privately.

Mr. Reid insisted on having an answer.

The Chairman said Mr. Fourdrinier was discharged because, in the discretion of the directors, they thought it would be advantageous to the company to obtain the services of Mr. Weaver, in the room of Mr. Fourdrinier.

The motion that the sum of £1,000 be given to Mr. Fourdrinier, in addition to the sum voted at the last meeting, was then put from the chair, and carried by a large majority, only a few hands being held up against it.

The meeting immediately afterwards broke up.

HALF-YEARLY MEETING OF SHAREHOLDERS OF THE LONDON DISTRICT TELEGRAPH COMPANY.

On Thursday afternoon the eleventh half-yearly ordinary general meeting of the shareholders of the London District Telegraph Company was held at the offices of the company, Cannon-street, for the purpose of receiving and considering the accounts, balance sheet, and report of the directors, and for the transaction of the general business of the undertaking.

There was a fair attendance of the shareholders, and the following directors were present:—Robert Taylor, Esq. (chairman of the company), who presided at the meeting; George Sheward, Esq., vice-chairman; Charles Kemp Dyer, Esq.; and Charles Reynolds, Esq.

The Chairman.—The secretary will read the advertisement calling this meeting.

Mr. Charles Curtoys, the secretary, read the advertisement by which the meeting was convened.

The report and statement of accounts, which had been some days in the hands of the shareholders, and which appeared in our last number, having been taken as read,

The Chairman said he was very glad to meet the shareholders that day, and he could have wished there had been a larger number present, because the time seemed to have arrived, or at all events seemed nearly to have arrived, when some anxiety was manifested as to when their receipts would meet the expenditure. The last time they met the directors contemplated or hoped for the fact that by the time the shareholders met this half-year they should be able to make both ends meet, and they would see by the accounts that the company had very nearly arrived at that position. They would find by reference to the accounts that for the half-year ending December, 1860, the deficiency was £2,168, and the next half-year ending June, 1861, it was £2,177 11*s.* 4*d.* From that time they had gradually gone on decreasing the deficiency, which they would find to be noted as follows:—after £2,177, it became £1,995, then £1,077, £894, £440, £796, and for this half-year the deficiency amounted to only £60 12*s.* Now, as to the fact of the public not so thoroughly appreciating the efforts of this company as he expected they would do, and as they ought to do, they could not help it; but still at the same time they should take courage from the past, and still look forward with confidence to the future, in the hope that when they met again there would be no deficiency. He hoped that the present was the last time they should meet together at which the question of deficiency would ever have to be entertained. He trusted that when next they met they would have the opportunity of congratulating themselves upon having realised a satisfactory surplus of income over expenditure. There had been a considerable increase in the number of messages. For the period ending June, 1863, the number of messages forwarded was 129,702, and for that ending June, 1864, 152,795. Taking hope from this, he fully anticipated that the present would be the last time they should have to meet to speak on the subject of a deficiency. When they looked at the amount of [illegible] this company had to raise, they would find that when they had [illegible]

corner, a very small sum would be sufficient to give the shareholders a dividend. Progressing next year as they had done during the past, he had no doubt that when they met again they should have the opportunity of congratulating themselves upon the fact that the directors had recommended the declaration of a dividend. When he was first induced to join the company he thought that there was in it so much of the element of usefulness, in a great commercial city like London, that it was one of those modern speculations that would speedily turn out successful. His anticipations had not been realised; but looking at the steady increase of the last two years, he felt confident that the time would soon arrive when they should be able to congratulate each other on this undertaking being a successful investment, instead of continuing to be, as hitherto, an unsuccessful one. He had to move that the report and statement of accounts be received and adopted. If any gentleman had any remarks to make or questions to put, he should be glad to hear him.

Mr. GEORGE SHEWARD, vice-chairman, seconded the motion.

Mr. EALES said he for one had always taken a very sanguine view of the prospects of this company, and was glad to find that the chairman entertained views of a similar kind. At the same time, he could not go to the same extent as the chairman, for, looking at the difference between the deficiency this half-year and the half-year ending at the same time in 1863, he found a reduction of about £380. If they deducted from that sum the net receipts in the second half-year of 1863, in order to follow out the estimate of the probable receipts for the coming half-year, there would be found still a considerable deficiency. It was rather a sanguine view to take of the matter to suppose that the receipts would immediately equal their expenditure. He should be glad indeed if that turned out to be the case, but he thought they would have to look a little farther on before they could make profit on the amount they had so long invested; and it seemed to him that the reason they had not been so successful hitherto was attributable to a deficiency of capital. He found that they had but fulfilled one-half of what they undertook to do, and what they hoped still to do. He found that in many cases there was such a delay in the delivery of messages that they could be as speedily delivered by messengers. Such should not be the case. Then again, it was originally intended to have stations all round the metropolitan district, within half-a-mile of each other, which, if carried out, would have a most beneficial effect. But in this they had been thwarted from want of funds. Many complaints had also been made of the inaccuracy of the messages, and some respecting the charges. In every point of view their misfortune—want of capital—had acted and re-acted upon them. And now that the affairs of the company had taken a better aspect, he would suggest that they should endeavour to carry out fully the propositions with which they started; but to do that it was clear that additional capital was required. The shareholders had every confidence in the directors, and he would take the present opportunity of suggesting for their consideration whether additional capital should not be raised. He hoped that at the next half-yearly meeting they should hear something on the subject.

The CHAIRMAN, in reply to Mr. Eales, said he could only say that the original proposition of the company was to have a hundred stations, which they considered would be sufficient for the purpose of encircling the metropolis. The Brighton Company's stations took in messages for this company, and so did the Magnetic, so that if they added those offices to their own they got up the exact number they intended when they started. With regard to delays in the forwarding or delivery of the messages, no one regretted that more than the directors and the manager. They did all they possibly could to prevent it, but frequently the material did not answer the desired purpose. They fined their clerks and messengers for delays, in order to maintain efficiency in their staff, and sometimes the directors would probably be considered harsh for their proceedings in this respect. Any suggestions made by shareholders were most acceptable, both to the directors and the manager. He trusted that before long this company would be paying not the fabulous dividends they sometimes heard of, but such dividends as would justify the early investments in this company as a safe undertaking. Nothing would be wanting on the part of the directors to promote the welfare of the shareholders and to further the success of the company.

Mr. EALES moved a vote of thanks to the chairman, who had always taken great interest in the affairs of the company.

The motion was seconded and carried amidst applause.

The CHAIRMAN, in acknowledging the compliment, said he had declined opportunities of becoming a director in other companies, and had associated himself with the District Telegraph Company, because he thought it was a very useful undertaking, and one which was eminently calculated to promote the vast commerce of this great metropolis.

The meeting then separated.

TELEGRAPHIC EXTENSION IN NEW SOUTH WALES.—We quote the following from the *Age* of the 14th of May:—"Mr. Cracknell, the chief superintendent, is on a visit to Victoria for the purpose of consulting with the head of the South Australian department, Mr. Todd, relative to the construction of an independent line of telegraph between South Australia and New South Wales. At present all messages between these colonies have to pass through the head station of the Victorian department—an inconvenience which has long been a subject of complaint as well as the cause of unnecessary delay."

CORRESPONDENCE.

INDIA-RUBBER COVERED CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Absence from London on a cable-laying expedition prevented my seeing a letter in your impression of the 16th ultimo, from Messrs. Hall and Wells, respecting the twenty miles of India-rubber covered core that was sent to me to be manufactured into a submarine cable for the Indian Government, and which I afterwards sent out to Bombay, according to instructions received.

Now I cannot say what treatment the cable met with after its arrival out, whether it was exposed to the sun or not, but Messrs. Hall and Wells are perfectly aware of the fact that no "hot tar" ever came in contact with their core at all. They know very well, as they had every opportunity of seeing, that the yarn is never used in my serving machines until hours after it is saturated with tar, and that it is wound on bobbins, which must necessarily give it time to get quite cold. They expressed themselves perfectly satisfied with the way in which I did the work for them, and if they knew that tar was injurious to caoutchouc, why did the specification compel me to use it? I could as easily have used tanned serving. If the injury was caused by the tar, how is it that the change in the India-rubber commenced on the inside, next the conducting wire? I dare say Messrs. Hall and Wells are very much annoyed at the failure of their core in the Persian Gulf, but it is hardly fair for them to try to get out of a scrape by shifting the blame on my shoulders. If tar caused the mischief (which I am certain it did not), then they have themselves to blame for causing it to be used. But the fact is, India-rubber stands no chance against gutta-percha. I have watched it carefully for years, and I was one of the first who covered wire with India-rubber as long ago as 1846, and if gutta-percha had never been introduced, caoutchouc would no doubt have been used both for submarine cables and land lines, to a limited extent, but gutta-percha is so immeasurably superior in every respect that it is like struggling against fate for the friends of India-rubber to endeavour to compete with it. I picked up a submarine cable last week that had laid more than ten years, and not the slightest change had taken place in the gutta-percha, and I feel certain that it would remain still as unchanged for a hundred or even five hundred years. Can we say as much for India-rubber, when we see it constantly changing? If we bury it in the sea, or in the earth, it becomes converted into treacle; if you stretch it in the air, it shrivels up and peels off the wire.

I have no interest whatever in upholding one more than the other, but I am so thoroughly convinced of the superiority of gutta-percha (having used upwards of 7,000 miles of wire covered with this insulator) that I should never use any other material when the option is given me.

I admit that gutta-percha has failed when extended in the air, and also when placed underground without proper protection, but I have within the last few years laid many miles underground, and also above, which will remain many years without showing signs of decay.

Messrs. Hall and Wells say they guarantee the cables made by themselves only. I do not believe they ever made a single submarine cable, and as regards their powers of production, they required three months to make the twenty miles of core in question, whereas I frequently get sixty miles per week of the Gutta-Percha Company, and I believe they could nearly double this.

I see, from one or two writers in your journal, they have fears that tar will prove destructive to gutta-percha: they may make their minds easy on that score; from tar, gutta-percha has nothing to fear, on the contrary it is one of the best preservatives.

I am very sorry to be obliged to run down India-rubber, but it has had plenty of trials, and, except in a few cases, has signally failed, whereas gutta-percha, if properly treated, never fails, consequently the latter substance must be preferred by those who understand the business they are engaged in, regardless of the strictures and adverse opinions of those who have had no experience and can know nothing whatever of the merits of the question.—Yours obediently,

W. T. HENLEY.

July 28, 1864.

THE ELECTRIC TELEGRAPH COMPANY'S MEETING.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—As we are indebted to your paper for much information on telegraphic matters, it may be interesting to many of your readers to have a brief outline of the meeting held, on the 3rd instant, at the Electric and International Telegraph Company's office. After the usual routine of business, it was made special for granting an additional thousand pounds to the ex-secretary, over and above the thousand pounds already voted to him at the April meeting; which first sum he received, and then applied for more—or the chairman applied for him. From all the information the shareholders could obtain, this gentleman, who had been in the service of the company for fifteen years, and had been receiving for a long series of years £750 per annum, was requested to send in his resignation, to make room, as the directors said, for a more efficient and energetic man. It would appear that some difficulty was in the way of getting the ex-secretary to do this. He did not like the idea of being shelved in favour of one of his own staff, and it was only on the promise of the directors to pension him for life at £300 a-year, that he consented. This having been agreed to, the directors,

in the full swing of their power, brought the proposition forward at the April meeting, and, much to their horror, and the honour of the shareholders, it was rejected. The shareholders at that meeting would have no hand in forming a pension list, but very generously granted him a sum of one thousand pounds, which he accepted; and thus matters were left until the meeting of Wednesday, when the chairman, having fortified himself with a strong party of his friends, and a powerful muster of the telegraph staff (who are enjoined to purchase as much stock as will give them a vote), again returned to the charge, made another demand on the shareholders for the second thousand, and carried it. Now, what I complain of is the power held by directors. In all cases they are enabled, by a rally of their friends, or by the iniquitous system of proxies, to swamp any meeting, whether the case be just or unjust. In this case, we have a gentleman receiving £750 a year, and now, through the caprice, or something worse, of the directors, the shareholders are obliged to support this gentleman in idleness, and pay him at the rate of one pound per day for seven years to come, and this whether there is any dividend or not left for the shareholders—this sum to a gentleman in the prime of life, who may turn to any other pursuit, or may join some opposition company against ourselves. This contrasts very strongly with the report of a banking company in the daily papers, viz., the Union Bank. The case was that of a ledger-clerk, who had been twenty-two years in the service of the bank, and had worked himself up to a yearly salary of £192. This man had retired through failing health, and having applied to his board for some retiring allowance, was offered the sum of £200 in full of all demands, take it or leave it. You will observe this is a case in the opposite extreme, and entirely performed by directors; and yet these men are bankers and merchants, and pay double the amount in dividends that we do, and know the value of money; but still shows the principle how much shareholders are in the power of directors, and who, once elected, there is hardly a possibility of displacing them.

Now, in the place of granting such large sums of money to such men as our ex-secretary, if it had been distributed amongst the hard-working staff who are toiling in the company's service, many of them only receiving sixteen shillings a-week, and on that scanty allowance obliged to keep themselves respectable, and even placed in situations of trust, I say had this sum, voted by the directors, been distributed amongst this class, it would have shown them to be sensible men, who had the interest of the company at heart. As it is, they show themselves deficient in commercial knowledge, and only prepared to carry out their own whims, and set the proprietary at defiance.

A Shareholder.

TELEGRAPHIC NEWS.

Electric and International Telegraph Company.—The directors of this company propose to pay a dividend of 4 per cent., for the half-year ending the 30th of June, on the 15th instant.

Telegraph Clerks' Provident Fund.—A soiree and conversazione is to take place for the benefit of the above fund, on the 8th instant, at Barnsbury Hall, Islington. The members of the International Dramatic Club have kindly volunteered to assist on the occasion.

Telegraphic Progress.—The Liverpool Town Council, at its meeting on Wednesday last, granted permission to the United Kingdom Electric Telegraph and the Universal Private Telegraph companies, to carry their wires above ground, instead of beneath the surface as hitherto.

Telegraphy in France.—We publish, with pleasure, that His Imperial Majesty the Emperor of the French has appointed Professor Hughes, the well-known inventor of the telegraphic instruments which bear his name, to be a "Member du la Conciel du Perfectionment," an appointment similar to the one occupied by the professor on the committee of the Board of Trade, in England, in the years 1859-60-61.

Damage to a Submarine Cable.—Under the above heading a paragraph appeared in this journal on the 26th ult. with respect to the injury sustained from an anchor by the Dover and Ostend cable, the property of the Submarine Telegraph Company. Mr. W. T. Henley requests us to insert the following correction, which we do with much pleasure:—"I undertook to make and lay twenty nautical miles from the Sandetti shoal to Dumpton Gap, near Ramsgate. This cable was to be spliced on to the Dover and Ostend cable as soon as the Magnetic Company had completed the land lines. They have not yet done so, so I have connected the cable to the other and buoyed it. I broke the Dover and Ostend cable in lifting, owing to its decayed condition. I was responsible for it, therefore had to repair it before laying the other."

Printing without Ink.—In the month of January an announcement appeared in the *Typographic Advertiser* of an invention which we thought exceedingly ingenious, and likely to prove of service on telegraph printing instruments: but the meagreness of the information imparted induced us to refrain from any comment thereon. We are now favoured with a few particulars which lead us to hope that a really useful invention has been perfected. "Mr. Hancock, of the Gutta-percha Company has been prosecuting a series of experiments with the view of dispensing with the use of printing ink, and has succeeded in chemically treating the pulp during the manufacture of printing papers, in such a manner that when the paper is impressed upon the uninked types the chemical particles are crushed, and a perfect black impression is the result."

A New Alloy.—A new alloy, described as applicable to the manufacture of all metal articles, bells, hammers, anvils, nails, and non-cutting tools, has been patented by Mons. M. H. Micolon, of Paris. The alloy consists of iron, with manganese or borax. The patentee takes twenty parts of iron turnings or tin waste, eighty parts of steel, four parts of manganese, and four parts of borax; but these proportions may be varied. When it is desired to increase the tenacity of the alloy, two or three parts of wolfram are added. When the cupola is ready, the iron and steel are poured in, and then the manganese and borax; finally, the vessel is filled up with coke; the metal is thus in direct contact with the fuel in the cupola, and by quickly running the fused mass into moulds, bells which possess the sonorousness of silver, whilst the cost is less than bronze, may be obtained.

Historical.—In 1766, 207,600 lbs. of gunpowder, which was stored in the church of St. Nazaire, in Brescia, Italy, was fired by a stroke of lightning, and the explosion reduced about one-sixth of the city to ruins, and killed 3,000 of the inhabitants.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.

India Rubber.

Para, first quality	1/9 to 1/10 ,,
second ,, ...	1/6 to 1/7 ,,
third Negro-head	1/2 to — ,,
Java and Penang	1/4 to 1/5 ,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	105 to 109	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	2 to 1 dis.	—
10	Mediterranean Extension Tel. .	all	$2\frac{1}{2}$ to $3\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{1}{4}$ dis. to $\frac{1}{4}$ pm.	—

TO CORRESPONDENTS.

Professor Hughes, E. F. G., and Omicron.—Received with thanks. Will appear in our next.

A Constant Reader.—We will reply to your query shortly.

*** Owing to the length of the reports of telegraph companies, a mass of valuable matter has been crowded out this week.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

Quarterly, 4*s.* 4*d.* | Half-yearly, 8*s.* 8*d.* | Yearly, 17*s.* 4*d.*

THE TELEGRAPHIC JOURNAL.

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SUBTERRANEAN TELEGRAPH LINES IN FRANCE.

By Professor Hughes.

France possesses a system for underground telegraphic wires, which has now had the test of several years' practical experience. There are over 2,000 kilometres of wire laid, all in a perfect state of high insulation, which, from the constant and uniform good results obtained, makes the French system worthy to be studied by electrical engineers.

There are seven distinct underground routes for these wires, which lead from the Central Station, in Paris, to the limits of the City, where they are joined (in a small office) to the air-lines leading to the different provinces of France.

In the French system, the iron tubes being solid and hermetically sealed during their entire length, the wires are entirely protected against any mechanical injury. The gases, which are the main cause of the deterioration of the gutta-percha, cannot enter the tube, and even if this infiltration should take place, which has never yet occurred, means are ready to establish a thorough ventilation of the tube. Water, for the same reason, never enters the tube, and, consequently, the insulation of these wires are invariably the same during all seasons of the year.

The following is a short description of these tubes, with the manner of joining them into separate determinate lengths:—Iron tubes, very similar to the ordinary gas tubes, are laid in a trench of 1 yard in depth; they are 2½ yards long, and their diameter is proportionate to the number of wires intended for use. A strong iron wire is introduced into these tubes, whilst being laid, in order to draw in a rope, which serves to introduce the cable. The tubes are then carefully cemented at their junctions with lead, for a distance of 50 yards. At each 50 yards a connecting tube, of a diameter sufficient to slide over the tubes in either direction, serves to join these sections when the entire work is accomplished; this leaves an open space at each 50 yards in order to admit the cable, which, when introduced, the connecting tube is drawn over the ends of the ordinary tubes, and by means of hammered lead carefully closed, thus joining the separate lengths into one entire whole. Larger tubes are employed where there are angles, and at each end of these curved tubes spaces are left for the connecting tube already mentioned. The gutta-percha wires, formed into a cable are introduced at each 200 yards, where they are united to the next section. In drawing these cables into the tube, the iron wire already within the pipe serves to introduce the strong rope, which draws the cable through the tubes. The cable is attached directly to an iron guide, having three iron rollers on its surface, in order to keep the guide in the centre of the tube whilst being drawn by the rope; the rope and cables are drawn through by a windlass, the rope passing over a pulley in the trench directly in the arc of the tubes. This operation is rapidly made with the aid of five men, who can easily lay one mile per day, including the joining up of the different sections, and the lines established in Paris by this system have all been made with great facility.

There are now 52 kilometres of subterranean lines in Paris, 1,450 kilometres of wire enclosed in these tubes. Two distinct routes leave the Central Station, branching to the Railways du Nord, Strasbourg, Vincennes, Lyons, Orleans, Sceau, and Rennes. The tubes vary from 60 to 120 millemetres in diameter, according to the number of the wires intended for use. Tubes of 60 millemetres receive easily 28 wires; 100 millemetres receive 49 wires; and those of 120 millemetres have 77 wires. The copper-conducting wire is formed of a strand of four wires, each having a diameter of half a millemetre. They are covered with two coverings of gutta-percha, giving in total a diameter of five millemetres. These are separately covered with tarred hemp, and formed into cables of seven wires, protected with a thick covering of tarred hemp. Ratties & Co., of Paris, are makers of these wires.

I have lately inspected these cables, which, during four years' use have never had the slightest defect, and I found that the gutta-percha was in a most perfect state of preservation. The tar having in some measure been absorbed, the gutta-percha was slightly coloured with the tar, but its original elasticity was preserved and its electrical conditions were in a more perfect state than when first laid.

The following are the results of the electrical tests, made with a very sensitive galvanometer, and with a Daniell's battery of from 100 to 200 cells.

Length of cable in kilometres.	Number of years in use.	Number of Daniell's cells.	Loss to earth on galvanometer through total length.	Amount of charge on galvanometer through total length.	Amount of discharge on galvanometer through total length.	Resistance of insulation in kilometres for each kilometre.
10	1½	200	1	5	4	1,000,000
10	4	200	0	4	4	4,900,000
6	3	200	½	9	8	2,000,000
6	4	200	⅛	3	3	1,000,000

The cost of laying subterranean wires by this system, at Paris, was as follows:—Iron tube, 120 millemetres diameter, in which are placed sixty-three wires, contained in nine cables of seven wires each. The entire cost of tube, trenches, placing wires, &c., complete, eight francs per yard, or twelve centimetres each wire per yard. The cables, with seven insulated wires, cost 2,900 francs per kilometre. This would make 414 francs each wire per kilometre, and, adding the cost of the iron tube, with laying, &c., the total price would be 534 francs per kilometre, and as these tubes are, after four years' use, in a most perfect state of preservation, it is but reasonable to suppose that they will be serviceable for many years to come.

Thus it will be seen that the French system, whilst giving superior electrical results, possesses, from its entire freedom of derangement, and from its duration, a great economy over all other telegraphs. This system is now being introduced throughout the provinces in France. Lyons has 192 kilometres; Bordeaux, 100; Rouen, 84; and at present it is being established throughout the city of Marseilles.

THE MEETINGS OF TELEGRAPH COMPANIES.

The annual and half-yearly reports of several telegraph companies have been presented to shareholders, and the proceedings at the various meetings of proprietors have been duly published in these columns. It will be unnecessary, therefore, on the present occasion to go into an analysis of the reports, or to criticise the doings at the meetings; but there are several matters in connection with these periodical renderings to which we shall advert. The directors of the Electric and International Telegraph Company met their shareholders with a very favourable statement, and the routine business of declaring a

dividend at the rate of 8 per cent. per annum was very quickly despatched. At the conclusion of the general, a special meeting was held for the purpose of considering the case of Mr. Fourdrinier, which gave rise to a deal of discussion on the occasion of the last meeting. With respect to the principle in dispute between the directors and the shareholders, we must coincide with the general view of the question taken by Mr. Glass, that the proprietors must leave the internal economy of a company in the hands of the directors; unless, through mismanagement, the affairs of the undertaking are discovered to be in jeopardy. This was not the condition of things in the instance under consideration, and we must, therefore, regret the captious spirit in which some of the shareholders received the proposition of the directors to award an additional £1,000 to Mr. Fourdrinier, in acknowledgment of long and faithful service. Notwithstanding a little opposition the meetings passed off very satisfactorily, and the old company is certainly in a very flourishing condition. The directors of the Mediterranean Extension Telegraph Company have also reported progress, and have declared a good dividend, besides appropriating a large sum to the reserve fund. The United Kingdom Electric Telegraph Company held its meeting on the 30th ultimo. Paradoxical as it may appear, when there is nothing to say it is a maxim with directors to make a voluminous statement. Accordingly we find the chairman's introductory address, on this occasion, teeming with encouragement, and his advice to shareholders was "hope on, hope ever." Proprietors get tired of the old story concerning "the present position and future prospects of the company," and sit impatiently whilst suppositionary statistics are glibly uttered. They know that "*if* they allowed the same increased proportion of messages to take place for the additional mileage about to be brought into operation, and *if* the number of messages increased in a similar ratio, the result would be" so-and-so; and *if* this, that, and t'other were put together and multiplied, the total would be equal to the dividend paid. It is very vexatious for directors to come before the proprietors once a-year with a long and uninteresting story of the magnitude of their operations and the increase of their traffic, with voluminous figures to show the grandeur of their enterprise—and figures will prove anything; but what does all this avail? It does not pay. It is unwelcome information to shareholders to hear that after leaving their capital unremunerative for four years they are still to wait for dividends; and when it transpires that the directors are entitled by an unseen and unread deed of settlement to £1,000 per annum for their services, and that some of the chief officers of the unprofitable concern are receiving princely salaries, it is not surprising that shareholders become dissatisfied, and that complaints are general. While this kind of management is tolerated, no great good can be predicated of the undertaking. The principle of a uniform cheap rate for messages is commendable, and is appreciated by the public; but until some new life is infused into the directorate, and until the exorbitant salaries of the chief officers of this company, as already observed, are brought within reasonable limits, the shareholders will stand but a remote chance of receiving a return for the capital invested. The London District Telegraph Company held its half-yearly meeting on the 4th instant. The report showed that a considerable reduction had been effected in the annual loss on the capital account, and a hope was expressed that the income next year would cover the expenditure, and enable the directors to recommend the declaration of a dividend. The affairs of this Company are managed with a scrupulous regard to economy, which will surely bring its own reward. The sphere of the London District Telegraph Company is limited, but when the public of the great metropolis learn to use the telegraph more generally, the property of this Company will prove to be the most profitable of all the telegraphic enterprises.

TELEGRAPHS IN THE FEDERAL ARMY.

We are indebted to the *American Artizan* for the following particulars of the telegraph in the camp, extracted from the Report of the Secretary of War:—

"The service of the field telegraph trains, in the hands of the corps, and making part of its equipment, has been conducted with a fair and, in some instances, a marked success of the different military departments. The liberality of the war department has allowed a development of this branch of the duty greater than was recommended at the date of my last report, and with results which have justified the action. It remains, in my view, only to follow the path of development indicated by the experience of the past year to secure for our armies a service of field telegraphs, with portable lines, so superior as to render our advance in improvements of this character as notable as those which have marked the progress of our armies in other branches of military appliances.

"In my last annual report there was brought to the attention of the department the improvement in telegraphic apparatus which the ingenuity of American artisans, stimulated by the field opened to them by this war, and the call for improved equipments for the trains for the signal corps of the army, had inaugurated. The practical experience of the past year, indicating the wants of the service, and the same ingenuity constantly exercised to overcome these wants and to perfect the material, have led to developments in the art which are now attracting the attention of electricians, and which, if they fulfil the promise of their seeming, will go far to revolutionize the appliances for the transmission of signals by electricity. It is already a subject of consideration whether the appliances and the modes for generating a magneto-electric current, as first used for telegraphy in this country, in the experimental instruments made for the signal corps to dispense with the clumsy and untransportable voltaic battery, are not these appliances and that mode which will be necessary to transmit signals through submarine cables of uncommon length, as that proposed to cross the Atlantic. This is, of course, theoretical only.

"The use of the instruments in the army has led incidentally to their examination for the naval force of the United States. Their use for civil purposes attracts attention. The ingenuity of the inventor, Mr. G. W. Beardslee, of New York,—turned to the subject of increasing the powers of the instruments to enable them to work at greater distances, and to apply the magneto-electric current in the same manner as generated by the field machinery, under circumstances when, with the first devised instruments, it was difficult or impossible,—has produced, with a construction novel in this country and in Europe, a signal-sounder, by which the signals transmitted are addressed to the ear; messages transmitted by this instrument may be read as with instruments of common usage.

"Experiments have been ordered with this apparatus. If, as is the opinion of the inventor, it can be used at any great distance, and with the compact and perfectly transportable apparatus of the magnetic instruments of field trains, it promises a development of field telegraphy before impossible, and will favourably influence the telegraphic enterprises of the country. Should the experiments ordered warrant the course, the signal trains of the army will be equipped with both the dial instruments already in use and the instruments now mentioned. There are opportunities for the employment of both. It is with some gratification that the attention of the Secretary of War is invited to these results. The credit of whatever success shall hereafter attach, in civil or military use, to American apparatus, based on these principles and on this style of its applications, will be largely due to that wise view of the war department which first gave it opportunity for development.

"During the year there have been in the service of the corps thirty field trains, distributed as follows:—

In the Army of the Potomac	5
In the Department of the Cumberland	5
In the Department of the Gulf	3
In the Department of North Carolina and Virginia	3
In the Department of the South	2
In the Department of the Tennesse	6
In the Department of Ohio	2
At the Signal Camp of Instruction, Georgetown, D.C.	3
At the U. S. Military Academy, West Point, N. Y.	1
Total	30

"Seventeen have been distributed since May 1, 1863. Of these

trains, some have been equipped with five and others with ten miles of insulated wire. There are carried in the trains lances for setting up the wire, when that is necessary; reels, portable by hand, carrying wire made purposely flexible for this particular use, and various minor appliances which experience has proven useful. A military organization is directed for each train.

"In duty of this kind, the style of construction of the trains, the equipment they are to carry, and the military organization to be provided for their use, to enable them to be most rapidly and anywhere brought into action, are the subjects for study. The particular instrument to be equipped is of secondary consideration. The soldiers drilled to the duty of construction acquire in a short time a remarkable skill in the rapid extension of these lines. As was anticipated, they have proved valuable auxiliaries to the services of the corps, and have sometimes rendered them available when they would, without, have been impossible. The greatest reported distance at which the instruments have worked is twenty miles. The average distances at which they are used are from five to eight miles. The average speed of the most rapid construction is reported to be at the rate of a slow walk.

"At the first battle of Fredericksburg, field trains were first in the history of the war used on the battle-field under the fire of the enemy's batteries. The movements to be made on the day of that battle were of the first magnitude. The movements of the retreat were perilous to the whole army. The trains in use contributed something to the success of those movements."

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

II.

In order to render the abridgments of specifications, in which electricity and magnetism are referred to, as complete as possible, the following brief summary of the progress of knowledge in reference to those imponderable forces and their applications, up to the time of the commencement of the patents, is prefixed. The summary also embraces any discoveries, inventions, or applications that are not treated of in the body of the work, at whatever date they may have been invented or brought into use.

This summary is divided into two heads:—1. Magnetism; 2. Electricity.

MAGNETISM.

This branch of the subject demands priority, being the most ancient form under which the action of the above-named imponderable forces was known. Under this head is included that species of force which is most developed in ferruginous matter, by which one particle attracts or repels another particle at appreciable distances; also applications of the phenomena consequent on these attractions or repulsions to useful purposes; also the nearly-allied force of diamagnetism.

The earth itself and the natural magnet or loadstone (called by some "lodestone") are the earliest examples of the magnetic power, although for countless ages such a power was unknown to man; and when the force was known, its simple and general properties were only observed in what may be termed the natural objects in which its manifestation was most apparent. The force itself was, during those comparatively dark ages, treated rather as a property of the loadstone itself (in relation to the earth and to iron), than as a distinct force, which could be transferred, and which more or less affects every substance on our globe, and most likely in the material universe. In tracing the slightest sketch of its history, therefore, it will be found that in early times the magnetic power was believed to belong only to the loadstone; it was next believed to belong only to the loadstone, and iron or steel; now, however, every material substance is found to be affected more or less by its influence. The imponderable forces of light, heat, and chemical action have also their action upon the magnetic force, and are acted upon by it. Even life itself (the vital force, *vis vivæ*) is believed by some to possess intimate relations to the magnetic power.

B.C. 2600-1040.—The Chinese discovered the attractive power of the loadstone. In reference to the loadstone's directive power, there is mention made of the employment of a needle "to determine the four parts of the world" on a "carr," in Duhalde's *General History of China*, when the Emperor Hoangti gave battle to Tchi Yeou (about 2600 B.C., according to Davis's *Chinese*, p. 83); "by this method he overtook Tchi Yeou, made him prisoner, and put him to death." In another part of the same book it is mentioned that Tchieou Kong gave certain ambassadors an instrument to direct them on their way home; one side of this instrument pointed towards the north, the other towards the south; this happened about 1040 B.C. Great doubts are, however, entertained of the veracity of the Chinese early history: therefore, of these epochs also. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 736; also *Abridgments of the Specifications relating to Marine Propulsion*, Part I., p. 4; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 1, 3, and 5; also Davis's *Chinese*, pp. 277, 278.)

B.C. 1000.—Magnes, a shepherd, is said to have been detained on Mount Ida, in Phrygia, by the nails in his boots or by his crook; the word "magnet" is thus supposed to be derived from the name "Magnes." Some authors derive the word "magnet" from the province of "Magnesia," in Lydia, whence the Greeks are said to have obtained the loadstone about 1000 years before Christ. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 735; also Sir W. Snow Harris's *Rudimentary Magnetism*, Parts I. and II., p. 1.)

B.C. 1000-600-500-400-100.—Homer (1000 B.C.); Thales, Pythagoras (600 B.C.); Euripides, Plato (500 B.C.); Aristotle (400 B.C.); the Roman poet Lucretius (in his philosophical poem, "De Rerum Natura"), an Cicero (100 B.C.), mention the attractive powers of the loadstone. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 735; also Sir W. Snow Harris's *Rudimentary Magnetism*, Parts I. and II., pp. 1, 2, and 3.)

A.D. 100.—Pliny, in the 36th book of his Natural History (written in the first century after the Christian era), has an obscure allusion to the repulsive power of the loadstone. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 8.)

A.D. 400.—Marcellus, who flourished about A.D. 400, "alludes to the magnet as the attractor and repulsor of iron." (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 8.)

A.D. 500.—The Chinese had craft "sailing on the Indian Ocean under the supposed guidance of south magnetic indication at least 700 years before it was employed by European nations," according to Humboldt's researches. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 135.)

A.D. 500.—Aëtius about the year 500, mentions that "those who are troubled with the gout in their hands or their feet, or with convulsions, find relief when they hold a magnet in their hand." (See *Aëtii Op.* l. ii. c. 25; also Beckmann's *History of Inventions*, Bohn's edition of 1846, Vol. I., pp. 43, 44.)

A.D. 1111.—The Chinese appear to have been long aware of the variation of the compass. In a Chinese work on medicine and natural history about 1111 the following passage occurs:—"When a steel point is rubbed with the magnet it acquires the property of pointing to the *south;* yet it declines always to the east, and is not due south. If the needle be passed through a wick (made of a rush) and placed on water, it will also indicate the south, but with a continual inclination towards the point *ping*, or five-sixths south;" this was the variation at Pekin. (See Davis's *Chinese*, pp. 277, 278; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 80.)

A.D. 1200.—Guiot de Province mentions, in a poem written by himself, that mariners used a "touched" needle, fixed on a bit of straw, prior to the year 1200, for a mariner's compass. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 736.)

A.D. 1242.—The captains navigating the Syrian Seas, in 1242, mounted a common sewing-needle on a piece of reed or cork, and allowed it to float on the surface of water, the sewing-needle having been rendered magnetic. This arrangement was used as a compass-needle. (See Klaproth, *Lettre à M. Humboldt*, p. 57; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 135, 136.)

A.D. 1260.—Paulus Venetus, in 1260, brought the compass from China to Italy, according to Dr. Gilbert. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 2.)

A.D. 1269.—Peter Adsiger, in a Latin letter (dated 1269) in the University of Leyden, sets forth an azimuth compass having a needle mounted on an axis, and mentions the declination of the magnetic needle. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 737.)

A.D. 1320.—Flavio de Giova, of Amalfi, is said by the Italian writers to have invented the mariners' compass about the year 1320. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 735.)

A.D. 1492.—Columbus remarked the variation of the compass in 1492. (See *Encyclopædia Britannica*, 8th edition, art, Magnetism, p. 2.)

A.D. 1576.—Robert Norman, a mathematical instrument maker in or near London, discovered the dip of the magnetic needle in 1576. and found it then in this latitude to be 71° 50', or thereabouts. (See De la Rive's *Treatise on Electricity*, Vol. I., p. 165; also *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 738; also Mary Somerville's *Connection of the Physical Sciences*, p. 335.)

A.D. 1590.—Julius Cæsar, a surgeon of Rimini, observed the conversion of iron into a magnet, by position alone, in 1590. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, pp. 2, 3.)

A.D. 1600.—Gilbert, in his work "De Magnete," published in 1600, "represents a blacksmith hammering a steel bar in the position of the inclined needle." (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 93, 94; also *Library of Useful Knowledge*, Magnetism, p. 25; also *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 739.)

A.D. 1622.—Professor Gunter, of Gresham College, discovered the change of declination in the same place in 1622. (See De la Rive's *Treatise on Electricity*, Vol. I., p. 165.)

A.D. 1630.—Gassendi, about 1630, observed that an iron bar was magnetic which had been in one position for a lengthened period of time, and had been struck by lightning. (See *Encyclopædia, Britannica*, 8th edition, art. Magnetism, p. 3.)

A.D. 1650.—Bond, about 1650, discovered the true progress of the deviation of the compass. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 3.)

A.D. 1683.—Dr. Edmund Halley, in 1683, published his theory of terrestrial magnetism. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 739.)

A.D. 1684.—Hooke, in 1684, heated iron rods in the magnetic meridian, and allowed them to cool in the same position, thus imparting magnetism to them. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 3.)

A.D. 1687.—Newton, in his *Principia* (published in 1687) notices the neutralizing effect of the interposition of an iron plate between a magnet and a body acted upon by it. (See Newton's *Principia*, 2nd Book, 23rd Prop., Sec. 5; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part. III., pp. 11, 12.)

A.D. 1700.—Morgagni, about the beginning of the 18th century, used the magnet "to remove particles of iron which had accidentally fallen into the eyes." (See Beckmann's *History of Inventions*, Vol. I., p. 44; also Maunder's *Biographical Treasury*.)

A.D. 1722.—Mr. Grayham, an instrument-maker in London, discovered the diurnal variation of the magnetic needle in the year 1722. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 739; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 86.)

A.D. 1722.—Marcel, in 1722, "observed that a bar of iron acquired a temporary magnetic state by position alone." (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 91, 92.)

A.D. 1730.—Savery, in 1730, magnetized hard steel bars by fitting one bar with armatures, and stroking the other bars with it, the bars being in the magnetic meridian. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 92, 93.)

A.D. 1734.—Swedenborg, in 1734, wrote upon magnetic phenomena. In his remarkable treatise, the "Principia," the spiral, helical, or vortical character of the motion of the force producing magnetic effects is prominently set forth and figured in drawings; various particulars respecting the declination of the magnetic needle are also stated; and many laws of the magnetic force theoretically indicated, that have since been proved by practical experiment. Experiments and illustrations abound in this work. (See *Principia Rerum Naturalium, sive Novorum Tentaninum Phænomena Mundi, elementaris philosophice explicandi*, Fol. Dresden, 1734, more particularly pp. 123-380, in Vol. I. of "Swedenborgii Opera.")

A.D. 1746-1747.—Dr. Gowan Knight, F.R.S., a London physician, in the year 1746-1747, proposed a method of magnetizing steel bars by gradually withdrawing the opposite poles of magnets from beneath them, the poles being in contact with the steel bars. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 84, 85.)

A.D. 1749.—Du Hamel, about the year 1749, made a further application of Dr. Knight's method of magnetizing. Two bars were magnetized at one time by being made the opposite sides of a rectangle, the other sides being formed by soft iron bars. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 85, 86.)

A.D. 1750.—Professor Wargentin, secretary to the Swedish Academy of Sciences, in 1750, noticed the effect produced on a magnetic needle by the northern lights. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 740.)

A.D. 1750.—Michell advanced the idea (in his treatise on Artificial Magnets, published in 1750) that in all the experiments of Hawksbee (1712), Dr. Brook Taylor (1721), Whiston, and Muschenbroek (1724), "the force really may be in the inverse duplicate ratio of the distances, proper allowance being made for the disturbing changes in the magnetic forces so inseparable from the nature of the experiment." (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 20.)

A.D. 1750.—Michell, in 1750, employed a method of magnetizing, which he designated as "the double touch." Several steel bars to be magnetised are placed in one straight line on a horizontal plane, and the opposite poles of two powerful magnets, or of a compound magnet, are moved backwards and forwards vertically over the series, beginning and leaving off at the centre. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 86, 87.)

A.D. 1751.—Mr. John Canton, an English philosopher, in 1751, combined the magnetizing processes of Du Hamel and Michell. (See *Library of Useful Knowledge*, Magnetism, p. 47; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 87.)

A.D. 1756.—Mr. Canton, about 1756 found (from 4,000 observations) that the daily variation of the needle was greater in the summer than in the winter months. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 739.)

A.D. 1757.—Euler, Bernouilli, and Descartes, about 1757, in terrestrial magnetism, advanced the theory that the magnetic fluid moved from the equator to the poles. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, pp. 4, 5.)

A.D. 1759.—Æpinus' celebrated treatise, "Tentamen theoriæ Electricitatis et Magnetismi," was published in 1759; this treatise contained a method of making magnets, and a theory of magnetism. The method of making magnets was a combination of Du Hamel's with Michell's "double touch;" magnets were used in place of the cross bars of soft iron. The theory was very like Franklin's single-fluid electric theory, but without the transference therein supposed. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 54; also *Library of Useful Knowledge*, Magnetism, pp. 33-36 and 47, 48; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 87, 88, and Part III., pp. 130, 131.)

A.D. 1760.—Mayer read a paper (not since published) before the Royal Society of Gottingen, in 1760. In this paper Mayer finds the force of magnetic attraction to correspond with the general law of that of gravitative attraction, viz., that it is according to the inverse duplicate ratio of the distances. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 20.)

A.D. 1770.—Father Hehl, about 1770, communicated his discoveries relating to the effect of certain magnetized steel plates in the cure of diseases, to Anton Mesmer. (See Beckmann's *History of Inventions*, Vol. I., p. 46.)

A.D. 1772-1773-1774.—Mr. Wales noticed the effect of local attraction upon mariners' compasses. This gentleman was the astronomer to Captain Cook during his voyages in 1772, 1773, and 1774, and made the above-mentioned observations during that period. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 745; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part. III., p. 161.)

A.D. 1775.—Graham, in 1775, suggested the determination of the magnetic intensity in different parts of the globe by means of the needle of oscillation or magnetic pendulum. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 93.)

A.D. 1776.—M. Lambert published two beautiful memoirs on the laws of magnetic action in the 22nd volume of "Histoire de l'Académie Royale des Sciences," Berlin 1760. In the first of these investigations, the action of a bar magnet upon a magnetic needle is set forth, the bar magnet being placed so that its axis is always pointed to the centre of motion of the needle, and at such a distance from the needle as to deflect it a given angle from the meridian; from the curve thus obtained the laws of magnetic action are assigned in reference to the needle's centre of motion. By this arrangement an equilibrium is obtained between three forces, viz., the magnetic force of the needle, the directive force, and the force of the magnet by which the needle is deflected or drawn from its meridian. The results obtained by this investigation are as follows:—First, "that the action of magnetism on a a magnetic needle, considered as a lever, is proportionate to the sine of the angle of obliquity of its direction; and that hence the effective force which operates in restoring the needle to its meri-

dian, when drawn aside from it, is directly as the sine of the angle of its deflection." Second, that the magnetic force varies in the inverse duplicate ratio of the distances, attended with the singular result that the common centre of attraction is outside of the needle; this fact approximates the analogy of magnetic force to that of gravitation in a remarkable degree. In the subsequent memoir the "curves of the magnetic current" are investigated by the "action of the directive or polar force of a "magnet upon a small needle;" the general laws of magnetism, and the position, size, figure, and force of the great magnet, which M. Lambert supposes to reside in the earth, are also examined. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 20-23.)

A.D. 1778.—Brugmans, in 1778, observed and recorded the repulsion of bismuth and antimony by the magnetic poles, thus laying the foundation of the science of diamagnetism. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 76.)

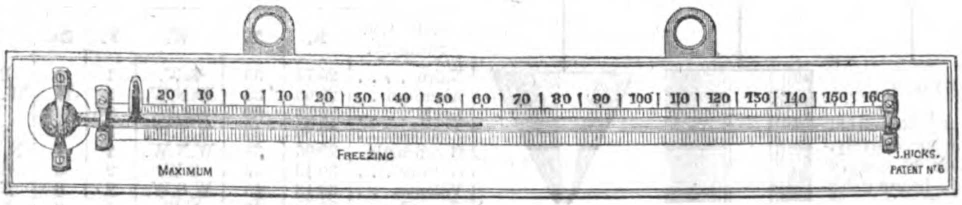
A.D. 1779.—Mr. Benjamin Wilson (in the Philosophical Transactions for 1779) published Dr. Gowan Knight's method of forming artificial magnetic paste, by means of comminuted iron and linseed oil. (See De la Rive's *Treatise on Electricity*, Vol I., pp. 203, 204; also *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 752.)

A.D. 1779.—Dr. Ingenhouz, in 1779, proposed a mariners' compass consisting of a magnetic needle enclosed in water or some other suitable fluid, in order to steady the needle. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 144, 145.)

A.D. 1780.—Coulomb, about 1780, propounded his double-fluid theory of magnetism; he also proposed a method of magnetizing by the "double touch," the bar to be magnetized being placed between two powerful magnetic poles. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 131, and Parts I. and II., p 88)

A.D. 1786.—Cavallo, in 1786, made many experiments, proving that brass acquires magnetic power by hammering. (See *Library of Useful Knowledge*, Magnetism, p. 90.)

SMITH, BECK, & BECK'S NEW MAXIMUM THERMOMETER.



IT has long been a subject of complaint on the part of those engaged in electrical investigations, that there existed no reliable and exact maximum thermometers. We have had an opportunity of examining a most ingenious and efficient instrument, which has recently been introduced by the well-known and eminent philosophical instrument makers, Messrs. Smith, Beck, & Beck, of Cornhill.

The great superiority of this instrument over all other maximum thermometers which have come under our observation consists in its extreme simplicity, and the impossibility of putting it out of working order.

There is in it no contraction of the tube, no particle of air, nor any metallic or other index for registering the maximum point, all of which plans are open to objection.

It differs in construction from an ordinary mercurial thermometer in having a supplementary chamber near the bulb-end, filled with mercury, as shown in the woodcut above.

When in use, this thermometer should be placed horizontally, and after each observation should be turned with the bulb downwards, until the mercury fills the supplementary chamber: the mercury in the bore then indicates the exact temperature at the time, and the instrument is set. As the heat increases, the mercury expands in the ordinary manner; but on a decrease of temperature, instead of the column in the tube receding, the bulb feeds itself from the supplementary chamber, the end of the column exactly indicating the maximum point.

MEDITERRANEAN EXTENSION TELEGRAPH COMPANY.

THE ordinary half-yearly meeting of this company was holden on Friday, the 5th instant, at the London Tavern, Bishopsgate-street.

There was a fair attendance of shareholders, and the following directors were present:—Sir James Carmichael, Bart., deputy chairman of the company; G. B. Carr, Esq.; Samuel Gurney, Esq., M.P.; and Alexander Devaux, Esq.

The chair was occupied by Sir JAMES CARMICHAEL, Bart.

The CHAIRMAN, in opening the proceedings, called upon the secretary to read the advertisement by which the meeting was convened.

This having been done by the secretary, and the report and statement of accounts having been taken as read,

The CHAIRMAN said he was sorry to have to apologise for the absence of their worthy chairman, who was prevented from attending the meeting from an attack of erysipelas, but he hoped that that was not of a very serious character. The half-yearly report was very short, and he trusted that they would think it was a satisfactory one. He did not think it was necessary for him to offer many remarks upon the report, but there was one point which required explanation. There was a slight decrease in the revenue, which was entirely owing to the interruption that occurred on the Malta and Alexandria line; but that line had now been thoroughly repaired and restored. The revenue now averaged more than £300 a week, which was upwards of a third more than that of last year. He thought that that would be considered very encouraging. Messages from Malta, which used to occupy one, two, and three days, now come in six or seven hours, which seemed to him to be a very satisfactory matter. And he trusted that, by the Italian Government effecting improved insulation, and carrying out other improvements at the different stations, they should be able to transmit messages in a much shorter time than at present between Malta and London. He should have to ask the shareholders for power to the directors to borrow from their bankers such a sum of money as would enable them to pay the dividend. He hoped that the present would be the last time when it would be requisite to ask the shareholders to grant the directors such powers, as the Italian Government had promised now to settle with them quarterly. He moved that the report and statement of accounts be received and adopted.

Mr. CARR seconded the motion.

Mr. F. W. FLOYD said, as a shareholder, who objected to the borrowing of money to pay a dividend, he wished to know if the directors had any idea when the next payment would be made by the Italian Government.

The CHAIRMAN.—We expect the payment daily; certainly it will be paid in a week or ten days. We may not have to borrow money at all to pay dividend, but the directors thought it desirable to ask power from the meeting to borrow money in case it should be requisite. He thought that the money due to them would be remitted in eight or ten days.

Mr. FLOYD.—Then it is only in case of necessity that you ask for borrowing powers?

The CHAIRMAN.—It is only in case of necessity.

Mr. FLOYD.—I would rather wait.

The CHAIRMAN.—But there is a certain stock of preference shares that must have the interest paid, and we thought it better that the whole of the stock should be paid at once.

Mr. FLOYD.—It is the appearance of borrowing money to pay a dividend.

The CHAIRMAN.—Yes, but then that is because we are waiting until a remittance is sent from Turin.

Mr. FLOYD.—Yes, but there is the interest; and besides, there is the very bad appearance of borrowing to pay dividend in the market.

The CHAIRMAN hoped that the present would be the last time when they should have any occasion to refer to a proposal to borrow money in order to enable them to pay a dividend.

THE CHAIRMAN then put the motion that the report and statement of accounts be received and adopted. The motion was unanimously agreed to.

The CHAIRMAN moved, that the directors be authorised to borrow from the company's bankers such a sum of money as would be necessary to mak up, with the balance in hand, a sufficient sum for the payment of divide

Mr. CARR seconded the motion, which was unanimously agreed to. n

The CHAIRMAN moved, that Mr. Samuel Gurney, M.P., and C Hamilton, the retiring directors, be re-elected directors of the company.

Mr. McDOUGALL seconded the motion, which was carried unani tors for

A SHAREHOLDER moved a vote of thanks to the board of d seconded their attention to the interests of the company. The motion v and carried unanimously.

The CHAIRMAN returned thanks, after which the meeting ke up.

ARRANGEMENTS FOR METEOROLOGIC TELEGRAPHY.

(Continued from page 56.)

In continuation of this treatise of Admiral FitzRoy's, we have illustrated with engravings the various cautionary or storm-warning signals employed. Fig. 1 represents the North Cone (referred to in No. 31, p. 56), which, inverted, represents the South Cone. Fig. 2 is the Drum, which indicates

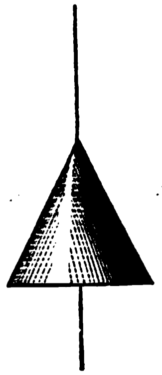


Fig. 1.

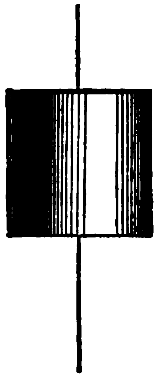


Fig. 2.

that storms may be expected from more than one quarter successively. Figs. 3 and 4 are used to convey intelligence of probable heavy gales (Fig. 3 from the northward, and Fig. 4, which is the same signal inverted, from the southward). The table following will enable the reader, after a little consideration, to fully comprehend the weather bulletins published in the journals of the day by the Meteorologic-office of the Board of Trade. The subsequent information will show the stations in connection with each telegraph company receiving cautionary signals.

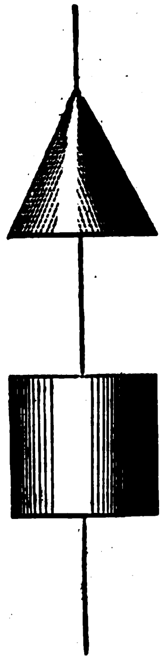


Fig. 3.

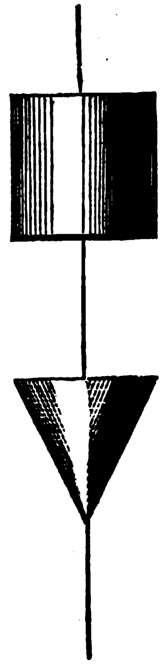


Fig. 4.

Weather Report for March 29th, 1864.

Eight A.M. Tuesday.	B.	T.	W.	F.	Ex.	D.	I.	R.	S.
Nairn	29·47	38	N.N.W.	4	5	N.N.W.	c	0·15	2
Aberdeen . .	29·39	39	N.W.	6	7	N.	s	0·25	4
Leith	29·45	42	N.	2	4	N.	o	—	1
Ardrossan . .	29·48	40	N.	2	5	N.W.	o b	—	2
Greencastle .	29·57	43	N.	4	9	N.W.	r c	0·14	2
Galway . . .	29·70	47	N.W.	4	9	W.S.W.	r c	0·11	2
Valentia . .	29·76	45	N.	4	9	N.N.W.	r o	0·15	5
Cape Clear .	29·72	44	N.W.	4	9	N.	c	—	5
Queenstown	29·54	44	N.W.	5	8	N.W.	c	—	2
Liverpool . .	29·35	41	N.N.W.	4	7	W.	c	0·23	4
Holyhead . .	29·44	43	W.N.W.	7	9	W.N.W.	c	0·18	5
Pembroke . .	29·48	44	N.N.W.	6	9	N.W.	c	0·12	4
Penzance . .	29·61	44	N.	8	10	N.W.	o	0·10	6
Brest	29·57	45	N.W.	8	7	N.W.	o c	0·32	6
L'Orient . . .	29·46	41	N.N.W.	5	5	N.N.W.	c	0·08	6
Rochefort . .	29·46	45	N.N.W.	7	5	N.W.	r o	0·12	7
Plymouth . .	29·47	44	W.N.W.	8	7	W.N.W.	o c	0·23	5
Weymouth .	29·35	43	N.N.W.	8	8	W.	c	0·11	6
Portsmouth .	29·27	40	N.	6	9	N.W.	r o	0·14	5
London . . .	29·21	39	N.	8	8	W.	h c	0·10	—
Dover	29·17	38	N.	8	6	W.	c	—	6
Yarmouth .	29·13	38	N.E.	4	8	W.N.W.	s c	—	2
Scarborough	29·75	40	N.N.E.	3	7	N.N.W.	s c	0·08	4
Shields . . .	29·34	39	N.E.	5	10	N.E.	s	—	7
Heligoland .	29·06	37	S.E.	3	6	S.W.	o r	0·12	8

PROBABLE.

Wednesday. On Northern Coasts. *Thursday.*

N.W. to N.E. and back, strong, squally, showery.	N. to W., strong, squally to moderate.

Western.

As above.	As above.

Southern.

W.N.W. to N.N.E., strong, squally. Rain or hail at times.	N.N.E. to W.N.W., strong to fresh.

Eastern.

N.W. to N.E. and back, gales to fresh. Some rain or snow.	As next above.

Northern = Scotland. Western = Ireland, Wales, and adjacencies.
Southern = English Channel and Biscay Bay.
Eastern = Eastward England and North Sea.

Cautionary signals on Monday.

Explanation.

B.—Barometer corrected and reduced to 32° at half tide level. Each ten feet of vertical elevation causing about one hundredth of an inch diminution; and each 10° above 32° causing nearly three hundredths increase. T.—Thermometer exposed in shade. W.—Wind, direction of (true—two points left of magnetic). F.—Force (1 to 12—estimated). Ex.—Extreme force since last report. D.—Direction of extreme force. I.—Initials; b.—blue sky; c.—clouds (detached); f.—fog; h.—hail; l.—lightning; m.—misty (hazy); o.—overcast (dull); r.—rain; s.—snow; t.—thunder. R.—Rain-fall, snow, or hail (melted), since last report. S.—Sea-disturbance (1 to 9). Z.—Calm.

Extract from Beaufort Scale, with Additions.

1 = b = blue (sky).	6 = o = overcast.
2 = c = clouds (detached).	7 = r = rain, rainy.
3 = f = fog, foggy.	8 = s = snow.
4 = h = hail.	9 = t = thunder. Lightning.
5 = m = misty (haze).	

And a repetition (as r r) is for much of either character.

Weather Report for March 12th, 1864.

Eight A.M. Saturday.	B.	T.	W.	F.	Ex.	D.	I.	R.	S.
Nairn	29·74	33	S.W.	1	5	S.W.	c b	—	1
Aberdeen . .	29·65	35	W.N.W.	9	10	W.N.W.	s b	—	3
Leith	29·83	38	S.S.W.	2	3	W.	o c	—	1
Ardrossan . .	29·86	40	N.N.W.	5	9	N.W.	o c	—	4
Greencastle .	29·95	39	W.N.W.	2	7	N.N.W.	h r	0·26	1
Galway . . .	30·13	42	S.W.	2	8	S.W.	r c	0·25	2
Valentia . .	30·18	45	W.S.W.	2	8	N.W.	c	0·36	5
Cape Clear .	30·20	48	N.W.	4	9	N.W.	r c	—	4
Queenstown	30·06	43	W.N.W.	2	7	N.W.	c b	—	1
Liverpool . .	30·05	40	W.	4	*10	W.	c b	0·10	3
Holyhead . .	30·08	43	W.S.W.	4	8	W.	c	0·15	3
Pembroke . .	30·16	44	W.N.W.	2	8	W.N.W.	b	—	3
Penzance . .	30·25	45	N.W.	2	9	W.	c	—	3
Brest	30·28	43	N.W.	5	7	W.	o c	0·47	4
L'Orient . . .	30·20	41	W.N.W.	3	7	W.S.W.	c b	0·12	3
Rochefort . .	30·32	48	S.	3	7	S.W.	r o	0·04	[illegible]
Plymouth . .	30·22	42	N.	1	8	W.S.W.	c f	[illegible]	[illegible]
Weymouth .	30·19	42	N.W.	3	8	S.W.	h b	0·13	[illegible]
Portsmouth .	30·13	43	W.N.W.	3	9	W.S.W.	r c	0·21	3
London . . .	30·06	40	N.W.	5	9	W.	r b	0·09	—
Dover	30·11	45	W.N.W.	1	8	W.S.W.	r b	—	1
Yarmouth . .	29·95	38	W.N.W.	8	10	W.S.W.	r c	—	[illegible]
Scarborough	29·86	38	N.W.	5	9	N.W.	r b	[illegible]	[illegible]
Shields . . .	29·87	38	N.W.	5	5	N.W.	b	—	3
Heligoland .	29·67	38	W.N.W.	9	8	W.S.W.	r o	0·20	4

* Extreme = 30 lbs. on foot.

PROBABLE.

Sunday. On Northern Coasts. *Monday.*

N.N.W. to S.S.W., strong to fresh. Some rain or snow in places.	S.W. to N.W. and N.E., strong to fresh. Squalls. Unsettled.

Western.

As above.	As above.

Southern.

N. to W. and S.W., strong to moderate. A few showers.	W.S.W. to N. and N.E., moderate, but unsettled.

Eastern.

W.N.W. to N.N.E., fresh. Squally. Unsettled.	As next above.

Cautionary signals on all coasts—Thursday and Friday.

Examples:—Weather Reports.

Eight A.M. Saturday, 12th March, 1864.

Telegrams as forwarded to London, and as converted in Reports.

Telegram . .	Rain. Misty till seven A.M. 16020 22086			96740 88126			96844 09866	
*Heligoland	B.	T.	W.	F.	Ex.	D.	I.	R.
Conversion .	29·67	38	W.N.W.	9	8	W.S.W.	r o	0·20
*Greencastle	08026 30074			93848 89125			99648 09671	
	29·95	39	W.N.W.	2	7	N.N.W.	h r	[illegible]

* Cautionary signals on Thursday.

*Liverpool .	At half-past one P.M., and again at a quarter to six P.M., the pressure was 30 lbs. on square foot. 01010 24102				92939 40224		00544 04113		
	30·05	40	W.	4	10	W.	c b	0·10	3

* Cautionary signals on Thursday.

Eight A.M. Tuesday, 29th March, 1864.

Telegram ..	02006 22097				95237 47428		97049 04322		
*Galway...	B.	T.	W.	F.	Ex.	D.	I.	R.	S.
Conversion .	29·70	47	N.W.	4	9	W.S.W.	r c	0·11	2
*Penzance..	Hail. Squally. 01005 28106				95043 44332		96448 08766		
	29·61	44	N.	8	10	N.W.	0	0·10	6
*Shields ...	— 04108				90540 39204		93054 05387		
	29·34	39	N.E.	5	10	N.E.	s	—	7

* Cautionary signals hoisted yesterday.

CAUTIONARY STORM SIGNALS.

By Electric and International Telegraph.

PLACES AND PERSONS WARNED BESIDES RESPECTIVE TELEGRAPHISTS.

Signal Stations.		
Lloyd's	—	Secretary.
Shipping Gazette	—	Editor.
Crystal Palace ..	1	Secretary.

NORTHERN.

Nairn	1	Penny. Receiver of Wreck.
Aberdeen	7	Collectors of Customs, Aberdeen, Peterhead, and Montrose. Harbour-master, Montrose. Bridge of Don. Burghead.
Dundee	3	Collector of Customs. Chamber of Commerce. Broughty Ferry.
Glasgow	1	Exchange Rooms.
Greenock	1	Collector of Customs.

WESTERN.

Roche Point....	1	Cork. Queenstown.
Passage East ...	2	Waterford. Dungarvan.
Wexford	2	Broadway.
Douglas—Man..	2	Castletown.
Maryport	1	Collector of Customs.
Workington	1	Collector of Customs. Harbour Office.
Whitehaven	1	Collector of Customs.
Barrow	2	Ramsden. Morecambe.
Chester	3	Queen's Ferry. Connolis Quay. Mostyn.
Bangor	5	Holyhead. Admiralty Office. Beaumaris. Port Penrhyn. Carnarvon. Port Dinorwic.
Milford	2	Haven.
Pembroke	2	Captain Superintendent Dockyard.
Llanelly	2	Harbour-master. Lloyd's Agent. Pembrey.
Swansea	2	Sydney Hall. Collector of Customs. Mumbles.
Cardiff	2	Harbour-master. Penarth.
Newport	2	Caerphilly.
Barnstaple	3	Ilfracombe. Instow. Appledore. Braunton. Lighthouse. Fremington.
Weston, S. M. ..	2	Pigott.
Penzance	5	Collector of Customs. Hayle. Mousehole. St. Ives.
Falmouth	3	Collector of Customs. Duckham. Pendennis. St. Mawes.
Burnham	1	Bridgewater.

SOUTHERN.

Penzance	5	Collector of Customs. Hayle. Mousehole. St. Ives.
Falmouth	3	Collector of Customs. Duckham. Pendennis. St. Mawes.
Plymouth	5	Commander-in-Chief. Collector of Customs. Stonehouse. Mount Batten. Bovisand. Cawsand.
Dartmouth	2	Brixham. Rickham.
Torquay	4	Exmouth. Teignmouth.
Weymouth	5	Senior Officer in Command; Portland. St. Alban's Head. Flaghead. Christchurch.
Hurst Castle....	2	Lymington.
Cowes	1	White, Docks. Secretary R.Y.S.
Ryde	2	Victoria Yacht Club.
Southampton ...	2	Exmouth.
Portsmouth	3	Commander-in-Chief.
Shoreham	2	Worthing.
Brighton	3	Hove. Rottingdean.
Newhaven	2	Seaford.
Eastbourne	2	Pevensey.
Hastings	2	Stevenson, Fishmarket.
Rye	2	Dungeness.
Folkestone	1	Collector of Customs.

EASTERN.

Berwick	5	Holy Island. N. Sunderland. Links. Dunbar. Eyemouth.
Belford	1	Budle.
North Shields...	5	Collector of Customs. Tynemouth. Cullercoates. Seaton Sluice. Blyth.
South Shields ...	1	Sunderland.
Hartlepool	2	Collector of Customs.
Whitby	2	Staithes.
Scarborough ...	2	Collector of Customs.
Bridlington	4	Sewersby. Flamborough Head.
Hull	4	Collector of Customs. Trinity (Spurn). Grimsby. Withernsea.
Lynn	2	Collector of Customs. Harbour-master.
Yarmouth	6	Collector of Customs. Sailors' Home. Winterton. Corton. Kessingland.
Boston	2	Secretary Permanent Library.
Lowestoft	2	Harbour-master.
Aldborough	2	Dunwich.
Harwich	5	Landguard Fort. Woodbridge. Orfordness. Orfordhaven.
Faversham	1	Navigation Office.
Ramsgate	6	Whitehead. Broadstairs. Newgate. Epple Bay Reculvers.
Ipswich	1	
Signal Stations..	=	159 + 2.

Telegraph Stations warn nearest Coast Guard.

CAUTIONARY STORM SIGNALS.

By British and Irish Magnetic Telegraph.

PLACES AND PERSONS WARNED BESIDES RESPECTIVE TELEGRAPHISTS.

NORTHERN.

Signal Stations.		
Leith	4	Collector of Customs. Edinburgh. N. Berwick. Granton Harbour-master.
Ardrossan	1	Greenock.

WESTERN.

Greencastle	3	Port Rush. Ballycastle. Port Ballintrae.
Galway	1	Collector of Customs.
Tralee	2	Harbour Office. Blennervilles.
Valentia	1	Knightstown.
Cape Clear	3	Skibbereen. Crookhaven.
Queenstown	2	Commander-in-Chief. Collector of Customs. Kinsale.
Waterford	2	Dunmore.
Kingstown	5	Harbour-master. Dublin. Wicklow. Howth. Clontarf.
Drogheda	2	Balbriggen.
Dundalk	3	Collector of Customs. Soldier's Point. Giles Quay.
Belfast	4	Collector of Customs. Harbour-master. Carrickfergus. Cultra. Donaghadee.
Liverpool	2	Observatory. Exchange. Collector of Customs. Mersey Yacht Club.
Runcorn	1	Bridgewater Agent.
Fleetwood	2	Harbour-master. Collector of Customs. Blackpool.
Preston	2	Lytham. Silloth.

SOUTHERN.

Dover	4	Harbour-master. Collector of Customs. Cornhill. St. Margaret's.
Paris	—	Ministère de Marine.
Jersey	2	Gorey.

EASTERN.

Middlesboro' ...	1	Tallows, Dock Office.
Redcar	1	Dove.
Deal	3	Collector of Customs. Kingsdown.
Heligoland	1	The Governor. Cuxhaven. Hamburg.
Signal Stations..	51	

Telegraph Stations warn nearest Coast Guard.

CORRESPONDENCE.

HAWORTH'S SYSTEM OF TELEGRAPHY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I have carefully perused the specification of Mr. Haworth's patent for telegraphing between distant places without conducting wires; and if the object of his multiple drawings and incomprehensible letter-press is to mystify, and so conceal the principle of his discovery, he has succeeded in one instance that I know of. A piece of information has come to my knowledge which may give your readers a key to the solution of this matter. Mr. Haworth asserts that he has sent telegraphic messages from London to Norwood by his new method. I am given to understand that when Mr. Cyrus Field was in London a few months ago, he made an offer of £1,000 to Mr. Haworth, if he would send a short telegraphic message to Norwood without wires, in the presence of several witnesses named at the time. A further offer was made jointly by Mr. George Peabody and Mr. Cyrus Field to guarantee to Mr. Haworth the sum of £100,000 for his patent, provided he would send a telegram across the Atlantic. Neither of these tempting offers were accepted. It may be that Mr. Haworth contemplates making more money by his invention than was offered by the gentlemen aforesaid; or mayhap Mr. Haworth would not satisfy an idle curiosity for the paltry sum of £1,000 (which he could have obtained without sacrificing a tittle of his patent right). Let the reason be what it may, I am not so verdant as to believe that these liberal offers would have been declined had there been any possibility of the challenges being accepted and the experiments satisfactorily performed. Sir, my opinion is (and I enclose my card in order to enable you to estimate what my opinion is worth) that Mr. Haworth's patent is a bottle of moonshine; but where he obtains the cash wherewith to prosecute his experiments in as absurd a theory as that of perpetual motion I am at a loss to divine. I hope it is neither directly nor indirectly out of the national Treasury.—Yours, &c., A THOR SON.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—As a practical telegraphist of some twenty-five years' experience, will you permit me to offer a few remarks upon the subject of Mr. Haworth's alleged most important discoveries. I have in my time witnessed many experiments with the view of proving the practicability of transmitting intelligence without the aid of insulated conducting wires, and amongst others those of the late Mr. James Bowman Lindsay. He took out a patent in 1854, for "a means of transmitting telegraphic messages by means of electricity through and across a body or bodies of water." The invention consisted of a method of completing the circuit of electric telegraphs through water, "without submarine cables, or submerged wires extending across such water, water being the connecting and conducting medium for the electric fluid." The two wires respectively connected with the battery and signal instrument on one side of the water were to be attached, "metal balls, tubes, or plates, placed in the water, or in moist ground adjacent to the water." The same arrangement was to be placed on the other side of the water, and the forward, as well as the returned current, passed between the respective plates. The inventor preferred to place the plates on one side of the water at a greater distance apart than the distance across the water; but in case this was not practicable, the battery power was to be augmented, and the size of the immersed plates increased (such is the case with Mr. Haworth's plan). It was also necessary to place the plates for the forward current opposite to each other, and the plates of the return current opposite each other, in precisely a similar manner as that adopted by Mr. Haworth.

Your obedient servant, OMICRON.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It would have been more acceptable (to your readers, at least) if your contributor "B. M." had continued to bewilder the aforesaid with his by no means new theory of force and form, instead of indulging in the doubtful experiment of trying to comprehend a system of telegraphy which, as he cannot fathom, he certainly ought not to ridicule. It is a certain indication of ignorance, and betrays a contracted grasp of intellect, and possibly the possession of mental powers dwarfed to lilliputian dimensions, when would-be clever persons strive to put the extinguisher of ridicule and sarcasm upon that which is beyond their grasp. "B. M."—the clever adept in the art of bewildering when dwelling on subjects of a recondite nature—should be the last person in the world to complain of being bewildered by Mr. Haworth, or any one else. My dear Sir, you *are* "*not* infallible," as you say; probably you are the same distance from that point as most of us, possibly a little more remote. Your contributor however, is candid—he confesses his ignorance. That is more than some will do, but, unfortunately, his ignorance is not characterised by anything of a commendable nature, since because *he* cannot see, ergo, Haworth and his system must be all humbug. Humility, modesty, and unassumingness become a philosopher.

Before any man blow the cold wind of incredulity upon a project, he should not only not understand how it can be done, but he should prove *de facto* that it cannot be done; and unless he is prepared to do this, it were more becoming for him to end his fruitless efforts of trying to comprehend the (to him) incomprehensible, by silence, coupled with renewed efforts; and by the reflection, that could our ancestors of a century back again "revisit the glimpses of the moon," they would esteem as little short of miraculous the way in which we have subjected the elements to our control, and made them our bond-slaves; and if in one short century, or, rather, half a one, such gigantic strides have been made, who shall put a limit to man's inventions and discoveries, and say, "hitherto shalt thou come, and no further." The womb of the future is big with great results, but it is the nature of man to grow conservative. Thirty years ago the staid conservative electricians of the present day would have been looked upon and were esteemed as the wildest of Utopian visionaries. But the science of electricity having been established, and grown to its present proportions, with a thoroughly organised staff of doctors, professors, and the rest, with whom all wisdom dwells, and who have a special privilege to dabble in its reconditics to the exclusion of every one else, as lawyers dabble in legal subtleties, and parsons in divinity—these eminent men are as much horrified, in their turn, at any innovation as were our aforesaid ancestors, who held the study of electrical science to be a tampering with the powers of darkness. And—necessarily being the repertories of all electrical knowledge, and the storehouse, to boot, from which all future discoveries in that line must emanate—what can be more presumptuous than the alleged discoveries of those outside the charmed circle; nay, what can be greater proof of the worthlessness of their boasted discoveries and inventions than the fact of their being outsiders, or, at best, interlopers, innovators, and that nondescript article which all good staid conservatives must treat with ineffable contempt? Can any good thing come out of Nazareth? And can any new discovery, or a deeper insight into known laws, and a more perfect adaptation of them in given circumstances, to accomplish given results, emanate save from the privileged class who assume to wear the mantle of wisdom, and something more? Where is your diploma, Sir? History continues to repeat itself, and will do so, I suppose, to the end of the chapter. The foremost people of this nineteenth century are fighting the battles of the scientific ages, and scientific men, when they find a science respectably established, and themselves smug doctors or professors therein, at once relapse into the chrysalis state, and spend the remainder of their days in admiring and experimenting upon the beautiful interior of their shell, the limit of which they believe bounds the horizon of human attainments; and philosophy even lends herself to assist in the same self-delusion. And hence it is that the car of progress, whether scientific or otherwise, is propelled mainly by laymen, who wear not the cloth, and with whom the chartered and orthodox would rather not hold communion, forgetful all the time that those truly great men, who helped to drop their lines in such pleasant places, and whom they have to thank for their goodly heritage, and all they know, to boot, were once heterodox, and perhaps, in the opinion of their contemporaries, dabblers in the black art.

"B. M." cannot see how Haworth can do it. His apparatus is an enigma to him. He cannot see how the results alleged to have been obtained by the elaborate arrangement are arrived at. It is not in consonance with known electrical laws, or appears not to be so, and hence he is incredulous, and pronounces the thing an absurdity. This is taking high ground. The writer assumes to have attained the *ultima thule*, and beyond that, of course, there can be nothing but the deluge.

I confess Mr. Haworth's method is a riddle to me. I cannot understand it, and to attempt to get an insight into the *modus operandi* by means of the specification of his patent is like, to use a homely phrase, "looking for a needle in a bottle of hay." For the sake of the metaphysician with the barbarous cognomen I wish it were otherwise. I know Mr. Haworth, and have conversed with him upon the subject, and, indeed, he has attempted to explain to me some of the principal features of his system; but as I have not been privileged to see it in actual operation, I am free to confess I am very little wiser. Nevertheless, I should hardly deem myself justified in doubting the validity of Mr. Haworth's word, as to his having been in constant electrical communication, by means of his own system, with a friend at the West-end, himself being at Brighton; far less should I deem myself warranted in ridiculing such a system, although the results may appear incredible.

Mr. Haworth is an earnest man, is no wag, and is certainly very jealous for the maintenance of the patent laws in all their integrity; and, indeed, it would not be waggery, but sheer madness, for any man to spend a fortune, and waste the best years of his life, in the development of a project if satisfactory results had not been obtained long ago. For myself, I do sincerely believe they have been obtained; and I am not a credulous individual, otherwise I might, on the representations of some well-meaning friends, believe myself legal heir to a dukedom.

"B. M." may rest assured "there are more things in heaven and earth than is dreamed of in his philosophy," not excepting the electrical part of it. And he would be a far cleverer man than either Faraday, Joule, or any of the other eminent names that adorn the annals of the nineteenth century, whose mental calibre should take in at one comprehensive grasp the height, length, breadth, and depth of any one science, and see its intricate laws laid bare and readable as the open page of a book. There are parts of the mysterious volume they never see, which are yet revealed to humbler minds. E. F. G.

INDIA-RUBBER CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—"The Manufacturers of the Core" seem to have trodden on Mr. Henley's corns, or else that gentleman fancies they have, his letter having been written, as anybody may see, while he was afflicted with a spasm of

asperity. It is a great pity objectionable personalities should creep into these matters. Nor do I think Mr. Henley would write such a letter as that which appeared in your last number in his moments of quiet, calm consideration. There is not one of your readers who has any knowledge of the matter that would endorse Mr. Henley's view that these gentlemen wanted to "shift the blame on to his shoulders." The fact is, both the one and the other may save their breath to cool their porridge, if they ever regale on such vulgar fare. "The Manufacturers of the Core" can hardly find fault with Mr. Henley, nor need Mr. Henley commit himself to the making of sweeping assertions in order to avenge an imaginary injury. As an accidental and impartial witness to the sheathing of the core in question (or at least a part of it), I am quite satisfied that the yarn was applied too soon after its emersion from the tarpot—I merely state a fact, be it understood, and do not enter upon the question whether this would or would not be injurious to the core—but in all fairness I am bound to admit that Mr. Henley was not responsible for this. The work was let out, I believe, from head-quarters to a gentleman whom we may term a concessionaire; probably he did not know a vast deal about this sort of thing, and anyhow he was impatient to have the cable finished, so that really sufficient time was not allowed to admit of the tarred yarn getting in a proper condition. The fact is, Mr. Henley and his men were in an awful stew about this bit of a job; the "dam boys" burnt the tar, and in their haste to get the yarn on the bobbins great bunch knots were tied in it half as big as one's fist to look at, instead of the strands being joined separately, and in their haste to get it off the bobbins on to the core, it was certainly applied in some instances in a comparatively seething state; and if there is any doubt about this, one had only to examine the cable when sheathed to find the tar oozing out between the spirals of the iron wire. But, as before stated, Mr. Henley could not help all this. If the gentleman concessionaire *must* be off to the Continent by a certain time, and *must* see the cable finished first, why Mr. Henley had no alternative but to do the best he could with it in the short time allowed, and it is quite unnecessary for him to state the reverse of all this in order to clear himself, since he was not responsible; nor can I conceive why he should don a cap which was never intended for his worthy head, as I think. Moral—for Government officials and others to cogitate over: Never hurry an important work like the manufacture of a submarine cable, and avoid creating a concessionaire, no matter how many dear old chums you may have, for "too many cooks spoil the broth."

Now a word to the "Manufacturers of the Core." You, gentlemen, I believe, have taken out a patent for the manufacture of submarine cables, which, so far as the core is concerned, has to be treated in a peculiar manner in order to obviate the serious objections hitherto in the way of the adoption of india-rubber cores. I have read the specification of your patent, and am of opinion that your mode of manufacture is the only safe one to ensure good and permanent cables made of this material. May I respectfully ask if the core of the cable in question was made according to your patent? and if not, why not? It is immaterial whether these queries are answered or not. I have the best possible answer in the possession of a piece of the core, which I have dissected from centre to circumference, and find it is *not made according to your patent*. A little bird whispers that you had no choice, that the gentleman under whose supervision the cable was made had his own peculiar notions, and that if you made the core at all it should be done rigidly to the letter of his instructions. Certainly, if this be so, it exonerates you from all blame, if the core is really showing symptoms of decay. But would it not have been wise under the circumstances to have stated that you had departed from your patent in certain particulars, and thus have prepared the public in an indirect way, that the onus of failure should not fall upon you. I conceive that you owed it to yourselves as manufacturers, and to the cause of india-rubber insulation, which you not unreasonably deem the palladium of submarine telegraphic failure, to have warned the public that you not only objected to the use of tar and iron sheathing, but that the core was made under protest, being a departure from what you consider the only safe mode of treating india-rubber when applied to that purpose.

We shall doubtless all willingly make allowances from Mr. Henley's misstatements of well-known facts. He says, "If tar caused the mischief, then they have themselves to blame for causing it to be used." And again, "Why did the specification compel me to use it (tar)?" Mr. Henley ought not to require to be told that he did *not* cover the cable for the "Manufacturers of the Core." Everybody knows that when they delivered the core at Mr. Henley's works they had nothing further to do with it; that the order for the core and the sheathing were *two distinct specifications*; and that the "Manufacturers of the Core" had no more to do with dictating what should be used in the serving than your humble servant, the writer of this. This is either unaccountable ignorance, or else the acme of disingenuousness, and the use of illegitimate weapons to cut and thrust out of sheer bad temper. The same may be said of the general sweeping assertions of your correspondent, which of course your readers will accept for as much as they are worth. The letter has every appearance of having been written under inspiration. With respect to india-rubber, practically Mr. Henley can know nothing about it, notwithstanding his broad assertion that he has "watched it carefully for years;" but of course he is wise in his generation. Who would not go with the stream? Certainly "india-rubber stands no chance against gutta-percha." I might just as well try to outbid Crœsus; but what if I should go on 'Change on an equal footing with the millionaire? The fact is, superiority goes for nothing here. We have to thank the "immeasurable superiority" (save the mark) of gutta-percha for the present deplorable condition of submarine telegraphy—bankrupt schemes, emasculated dividends, universal collapse, and no long cables—oh, yes! this golden dream of "immeasurable superiority" (and it is a golden reality to a few), I would it were true for the sake of a better though more modest insulating agent. The almost universal failure of gutta-percha has been the greatest difficulty in the way of india-rubber cables. It has shaken public faith in telegraphic enterprise, and so kept a worthier rival out of the field; but it is time the film of delusion was torn away from the eyes of a credulous world. Well, and what next? Why Mr. Henley has used 7,000 miles of gutta-percha wire, and will use nothing else if he can choose. I should think not, indeed; nobody expects he will be so green. But it would be doing a real service to your readers and the public if Mr. Henley would say how many miles of cable have failed, and how many are in work, of his laying. There is always a vast parade made of the number of miles of wire made and laid, but the statement is out of all proportion to what we know to be the actual mileage in working order; they should at least be candid, and show the other side of the ledger.

But bless you "gutta-percha never fails"—at least, you know, if—we have Mr. Henley's word for it, and he might as well have left out the qualifying "if;" and he is "very sorry to be obliged to run down india-rubber." Make your mind easy, my friend, upon this point, and allow me to congratulate with you that it is out of your power to perform the feat, being a handicap in which you or any one else having the hardihood to venture would be certain to come off losers.

With all deference to Mr. Henley's experience, your readers will hardly be reassured as to the effects of tar in gutta-percha; for the sake of the shareholder in posse and in esse, I hope he is right. BEPPO.

THE ORGAN OF THE TELEGRAPH SERVICE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Pardon me if I am out of place in referring to a matter that cannot have failed to strike the attention of others beside myself. In looking over the columns of the railway journals and other class papers no one can fail to perceive that these organs receive considerable support and countenance from the principal companies or firms engaged in the business represented. On reference to your columns, Sir, I note a total absence of companies' announcements. I have had some experience in the publishing department of a newspaper, and I am aware that the patronage of some people fetters and retards the exercise of the editorial functions; but I think at least that the telegraphing companies, the telegraph manufacturing companies, and others, having nothing to fear from honest criticism of their acts, should recognise the *Telegraphic Journal* as the organ of the service by keeping advertisements in a conspicuous position of your valuable paper.—I am, Sir, yours respectfully, AN OBSERVER.

LAW INTELLIGENCE.

SPENS v. WILLETT. THE UNITED KINGDOM ELECTRIC TELEGRAPH COMPANY (LIMITED), GARNISHEES. ATTACHMENT OF SHARES. IMPORTANT POINT.—This case came on for hearing in the Lord Mayor's Court, on Thursday last. Mr. O. B. C. Harrison for the plaintiff, sought to attach certain shares which were registered as the property of the defendant in the Company's books. Mr. Salter, for the Company, urged that the plaintiff could not attach the shares, as they were absolutely the property of defendant. His Lordship saw considerable difficulty in the way. Mr. Harrison was willing to accept the shares, if defendant would consent to transfer them. His Lordship found that certain stocks and public securities were exempt from attachment by act of parliament, and that was certainly in favour of the argument that other securities in the act were liable. Mr. Salter asked how many shares the plaintiff would take at par. The debt was £81. 11*s*., and the shares were £5. It was then agreed that 16 shares should be attached, subject, if necessary, to the opinion of the Court above.

TELEGRAPHIC NEWS.

TELEGRAPH CLERKS' PROVIDENT FUND.—Her Royal Highness the Princess Louis of Hesse has become a patroness of the above Fund, and has subscribed the sum of £5 to the institution.

EXTENSION OF THE ELECTRIC TELEGRAPH.—By a telegram from Suez we learn that the King of Ava has granted a concession for the introduction of railways, electric telegraphs, and steamboats into his dominions.

GOVERNMENT RETURNS RELATING TO ELECTRIC TELEGRAPHS IN INDIA.—Statement of the entire expenditure in England on account of electric telegraphs in India, viz., on purchase of stores, freights, instruction of assistants, passage money, &c.—In the year 1852-3, £30,475 12*s*. 1*d*.; 1853-4, £48,215 18*s*. 11*d*.; 1854-5, £1,871 13*s*.; 1856-7, £43,951 6*s*. 4*d*.; 1857-8, £114,346 19*s*. 10*d*.; 1858-9, £23,071 1*s*. 9*d*.; 1859-60, £2,014 10*s*. 2*d*.; 1860-1, £25,598 14*s*. 4*d*.; 1861-2, £95,869 15*s*. 6*d*.; £385,415 11*s*. 11*d*. Less recoveries in 1855-6 in excess of expenditure, £15 8*s*. 9*d*. Total, £385,400 3*s*. 2*d*.

A Telegraphist Honoured.—It is stated that Professor Morse, the inventor of the well-known instrument bearing his name, has had six orders of knighthood conferred upon him by the various Sovereigns in Europe.

The Persian Gulf Cable.—It was published in the daily papers of last Monday that the cable had parted. We have made enquiries in well-informed circles but have failed to obtain any satisfactory evidence corroborative of the report.

Telegraphic Connection of the whole of the Greek Islands.—An Athens letter states that Mr. Bufleb, the Levant Submarine Telegraph Company's agent at Scio, has made the Hellenic Government, on behalf of the Company, an offer to connect Athens telegraphically with Alexandria, Malta, and the whole of the Greek Islands, on either of the following terms:—(1) That, in consideration of a thirty years' concession, the Company would lay the necessary cables, pay all the working expenses, and transmit the Government's messages free; or, (2) that the Company, as before, laying the line, the Government should pay the working expenses, and the profit arising from traffic be equally divided between the two. The offer had been favourably entertained, and was to be submitted to the National Assembly for its consideration.—*Malta Observer*.

A Telegraph Clerk Tried for Manslaughter.—Jones Yendoll was charged at the Monmouth Assizes, on the 5th instant, upon an indictment and a coroner's inquisition, with the manslaughter of John Williams, at Aberystwith. The prisoner was the telegraph clerk at the Aberbeeg station on the Western Valleys Railway. The deceased was the driver of a passenger train on that line, and was killed, together with one William Worthing, through a collision that occurred on the line between Aberbeeg Junction and Victoria Station, by the meeting of the passenger train and a pilot engine and a goods train, about two miles from Aberbeeg and half-a-mile from Cwm, on the 17th of March. The railway is worked between Aberbeeg and Victoria with a single line of rails, and the rules of the company provided that the telegraph clerk should not allow a train to leave Aberbeeg for Victoria without first telegraphing to see if the line was free. The prisoner's negligence was alleged to be that he gave a pass to the guard of the up passenger train without receiving one from the guard of the goods train and pilot engine. He had, in addition to his duties as telegraph clerk, to issue tickets and make up his accounts in respect of all trains during every day of the week, not excepting Sundays, and he had also to attend to the parcels department. There were sixty or seventy trains a day to be worked by telegraph. The learned judge summed up, and said that persons must without doubt perform any duties they undertake, but the jury must be satisfied, in order to convict the prisoner, that there was a culpable omission on his part to perform his duty. The jury found the prisoner Not Guilty.

MISCELLANEA.

The Nobleness of Labour.—Labour, for a fair remuneration, whether of the brain or hand, should be the glory of any country; besides, there is true dignity in labour, especially in cultivating the soil. The object which the farmer has in view is to subdue the earth, to eradicate the briers and thorns, and to plant in their stead what is useful and beautiful to man. "Labour," says a noble worker, "has been made by Nature the law of man's condition. It is the price at which whatever is valuable in life must be earned. Whatever, therefore, degrades labour as the business of life, or renders it distasteful or dishonourable, does violence to our social laws no less than to a wise economy." All improvement—all progress of the race in civilization, has been the result of intelligent labour. It has built our cities, dug our canals, constructed our railroads, developed our lead, copper and iron mines, built our steamers and ships, given life and energy to the industrial arts, and, above all, is feeding and clothing our people and providing for their happiness. "The nation," says Dr. Samuel Johnson, "that can furnish food and raiment, those useful commodities, may have her ships welcomed at a thousand ports, or sit at home and receive the tribute of foreign countries, enjoy their arts or treasure up their gold." Let all labour, therefore, be crowned with honour; that labour, especially, that contributes so much to the welfare of man.

Appearance of the Sun from the North Pole.—To a person standing at the north pole the sun appears to sweep horizontally around the sky every twenty-four hours without any perceptible variation during its circuit in its distance from the horizon. On the 21st of June it is 23° 28′ above the horizon, a little more than one-fourth of the distance to the zenith, the highest point that it ever reaches. From this altitude it slowly descends, its track being represented by a spiral or screw with a very fine thread, and in the course of three months it worms its way down to the horizon, which it reaches on the 23rd of September. On this day it slowly sweeps around the sky with its face half hidden below the icy sea. It still continues to descend, and after it has entirely disappeared it is still so near the horizon that it carries a bright twilight around the heavens in its daily circuit. As the sun sinks lower and lower, this twilight gradually grows fainter till it fades away. On the 20th of December the sun is 23° 28′ below the horizon, and this is the midnight of the dark winter of the pole. From this date the sun begins to ascend, and after a time his return is heralded by a faint dawn which circles slowly around the horizon, completing its circuit every twenty-four hours. This dawn grows gradually brighter, and on the 20th of March the peaks of ice are gilded with the first level rays of the six-months' day. The bringer of this long day continues to wind his spiral way upward till he reaches his highest place on the 21st of June, and his annual course is completed.

Some New Facts in Relation to the Sunbeam.—The boundless extent of physical science is forcibly illustrated in the study of the sunbeam. What could seem more simple at first sight than a ray of light? And yet it would require long study to learn all that has been ascertained in relation to it. First was Newton's discovery that the white ray might be split into seven brilliant and beautiful colours. Then it was found that the ray was a compound of three elements—light, heat, and the actinic rays—those which produce the changes in the photograph and effect all other chemical actions of the sunbeam. Finally, within these few years has come the great discovery that the light produced by burning different substances is not only different in appearance, but when spectra are formed by passing these different kinds of light through a triangular prism, the spectrum of each element is crossed by lines peculiar to itself. Consequently, however far light may travel, it bears in its constitution the evidence of its origin, and thus brings to us from the sun and from the stars a knowledge of the substances which are glowing in those distant bodies. Each of the three elements of the sunbeam—light, heat, and the actinic rays—has been subjected to a great number of minute and delicate observations, and many curious facts have been learned in relation to each. Among other things, it has been found that some substances which allow light to pass freely through them are almost wholly impervious to heat. Professor W. A. Miller has recently been engaged in ascertaining a similar series of facts in relation to the actinic rays. He finds that the same law applies to these: bodies which possess an equal power of transmitting the luminous rays vary very much in their power of transmitting the chemical rays. This is an important fact in photography, as it is desirable to have the lenses of photographic cameras constructed of substances that will transmit a large proportion of the actinic rays. Of all the substances examined by Professor Miller none was found to surpass rock crystal in diactinic power. Water, ice, and white fluor-spar rival it, and pure rock-salt approaches it very closely. None of the different varieties of glass transmit rays extending beyond one-fifth or one-sixth the range afforded by quartz. A plate of glass less than 1-100th of an inch in thickness cuts off these rays almost as completely as a plate of twenty times the thickness. The vapour of water transmits the actinic rays freely, although it is extremely impervious to those of heat. Of the liquids examined, water is most diactinic, and next in order alcohol.

Heat Produced by Different Kinds of Fuel.—Several men of science have undertaken series of experiments to ascertain the exact quantity of heat developed in burning a given quantity of various substances. The most satisfactory of these experiments are those of Andrews, and those of Favre & Silbermann. Andrews inclosed the substance to be burned, together with just the quantity of oxygen required to burn it, in a close copper vessel with thin walls, and immersed this vessel in water—the water being carefully weighed. The substance was then set on fire by an electric current, and the temperature of the water was measured before and after the burning by a thermometer so delicate that it indicated $\frac{1}{300}$th of a degree. The apparatus of Favre & Silbermann was essentially the same, though they adopted some extra precautions to guard against the influence of the external atmosphere. The table below gives the results obtained by these two experimenters. It will be observed that the rise in the temperature of the water is given in degrees of the centigrade thermometer, which may be reduced to Fahrenheit degrees by multiplying the amount by 9 and dividing by 5:—

Substances burned.	Heat Units. Pounds of Water raised 1° C. by 1 lb. of each Compound.	Pounds of Water raised 1° C. by Combination of 1 lb. of Oxygen.	Compound formed.	Observer.
Hydrogen	34,462	4,307	HO	Favre & Silbermann.
Hydrogen	33,808	4,226	HO	Andrews.
Carbon	8,080	3,030	CO_2	Favre & Silbermann.
Carbon	7,900	2,962	CO_2	Andrews.
Sulphur	2,220	2,220	SO_2	Favre & Silbermann.
Sulphur	2,307	2,307	SO_2	Andrews.
Phosphorus	5,747	4,509	PO_5	Andrews.
Zinc	1,301	5,285	ZnO	Andrews.
Iron	1,576	4,134	Fe_3O_4	Andrews.
Tin	1,144	4,230	SnO_2	Andrews.
Copper	602	2,394	CuO	Andrews.
Carbonic oxide	2,431	4,253	CO_2	Andrews.
Carbonic oxide	2,403	4,205	CO_2	Favre & Silbermann.
Protoxide of tin	521	4,349	SnO_2	Andrews.
Suboxide of copper	256	2,288	CuO	Andrews.
Marsh gas	13,063	3,266	—	Favre & Silbermann.
Marsh gas	13,108	3,277	—	Andrews.
Olefiant gas	11,942	3,483	—	Andrews.
Olefiant gas	11,858	3,458	—	Favre & Silbermann.
Alcohol	6,850	3,282	—	Andrews.
Alcohol	7,183	3,442	—	Favre & Silbermann.
Ether	9,027	3,480	—	Favre & Silbermann.
Oil of turpentine	10,852	3,294	—	Favre & Silbermann.
Bisulphide of carbon	3,401	2,692	—	Favre & Silbermann.

The Lenoir Engine.—The engine invented by M. Lenoir, of Paris, under the auspices of the Imperial Gas Company of that city, and now in extensive use there, is thus described:—The Lenoir engine is in appearance and style very much like a horizontal steam engine. The cylinder has the necessary slide arrangements for the admission of gas and atmospheric air in due proportions. The gas is ignited by an electric spark from a battery connected by insulated wires, to each end of the cylinder. The daily cost of gas and chemicals is trifling; there is no boiler and no chimney. It can be worked on any floor of a house, and almost under any circumstances. As soon as the work required of the engine is completed, the gas is turned off, and the engine ceases. The saving effected by this engine over ordinary steam engines is estimated at 75 per cent.

The Science of Chemistry.—This science is not only of advantage to agriculture, physics, mineralogy, and medicine, but its phenomena are interesting to all men. The applications of this science are so numerous that there are few circumstances of life in which the chemist does not enjoy the pleasure of seeing its principles exemplified. Most of those facts which habit has led us to view with indifference are interesting phenomena in the eyes of the chemist. Everything instructs and amuses him; nothing is indifferent to him, because nothing is foreign to his pursuits; and nature, no less beautiful in her most minute details than sublime in the disposition of her general laws, appears to display the whole of her magnificence only to the eyes of the chemical philosopher. All material bodies are the subjects of chemical research. The solid and fluid matter composing the terraqueous globe which we inhabit, also air, light, and heat, are subjects proper for the examination of the chemist. The arts of dyeing, bleaching, tanning, glass-making, printing, working metals, &c., are purely chemical. The vegetation of plants and some of the most important functions of animals have been explained upon the principles of chemistry. By means of this science agriculture and gardening have been greatly improved. Chemistry directs the labours of the husbandman and the rural economist. In the dairy milk cannot be kept sweet and fresh, and butter and cheese cannot be made, without skill founded on chemical principles. Cookery and the art of curing and preserving beef, bacon, hams, and all animal and vegetable substances, are entirely chemical. The art of brewing, distilling, and making all sorts of fermented liquors depends upon the principles of chemistry. In medicine and pharmacy great benefits have been derived from the discoveries of chemical philosophers. The chemist resolves bodies into their elementary principles, and he examines their nature and properties when in a detached or simple state. He thus discovers their mutual relation to one another, and can recombine them in proportions different from those in which they were originally united. Hence new and useful compounds may be formed which nature does not produce. But chemistry is not only valuable as an art which supplies many of the wants, comforts, and luxuries of life. Its objects are sublime and beautiful in other senses; for it is intimately connected with most of the phenomena of nature, as clouds, rain, snow, dew, wind, earthquakes, &c.

"Visible Speech."—Mr. A. Melville Bell, well known in Edinburgh and elsewhere as an accomplished elocutionist, seeks to introduce what he considers a new art—that of "visible speech," by which every language may be made universally legible exactly as spoken. This he believes he has accomplished by means of "self-interpreting physiological symbols, based on a discovery of the exact physiological relations of sounds;" and, holding that his invention is one of "cosmopolitan interest and importance," he seeks to introduce it to the notice of "the representatives of Governments, as the proper patrons of a Universal Alphabet." He offers personal demonstrations of his system; and from a test afforded us, it certainly appears worthy of patient consideration and investigation. In the sort of prospectus he has issued for the purpose of introducing the scheme to the attention of Governments, Mr. Bell says:—"The alphabet of physiological symbols now invented presents, as it were, pictorially to the eye all the organic relations of the elementary sounds, and in these exhibits at a glance the principles which govern the mutations of letters and sounds in passing from language to language, and so casts a flood of light on the secrets of etymology; and that, by a peculiar feature of the invention, all the sounds of every language are represented by so small a number as thirty-four types. The number required for the printing of any one language is, of course, smaller. The English language, for instance, requires only twenty-two types for the most minutely accurate phonetic symbolisation of all its vowels and consonant elements. This apparently marvellous result has been attained through a physiological discovery of the exact formations, and of the mutual relations, of linguistic sounds. Among its practical applications he suggests the following:—"The electric telegraph will deliver its messages with the exactness of *viva voce* utterances. Despatches may be transmitted in any language, through any country, and no necessity for translations can ever arise. An English clerk would manipulate a message in Russian, Hindustani, or Chinese with the same facility that he would one in his own tongue." He adds that "no instance of failure has occurred in the perfect symbolisation of the most difficult words selected from the following languages:—American, Indian, ancient Greek, Arabic, Danish, English, French, German, Hindee, Hungarian, Italian, Latin, modern Greek, Persian, Polish, Portuguese, Russian, Scottish, Spanish, Urdu." He says:—"The applicability of the physiological symbols to Chinese, or to any other language (or dialect), will be demonstrated to competent investigators;" and furnishes credentials referring to the above nineteen languages, which leaves no room for a doubt of the universality of the invention.—*Scotsman.*

Novel Lightning Conductor.—This invention consists in a conductor composed of a continuous strip of copper without any joint, unless to form the tip or point, placed close against the building or structure to be protected without insulation, and secured thereto by strips of the same or other metal placed across it and nailed to the building or structure. It also consists in a novel mode of forming the tip point of such a conductor from the strip itself, thereby making it entirely continuous from end to end.

Inventors and Inventions.—Let us not cheapen inventions, but be kind and encouraging to the inventors; beware of killing the goose that lays the golden egg! Many inventors die before the hour of triumph; others falter on the way. Invention is a struggle, a conflict, almost a battle; if the victors are rewarded, the dead are honoured and the wounded carefully attended to. Glorify the inventors who succeed; cover with an indulgent self-respect the faults of those who fail; and soothe the last years of the wounded—those invalids of industrial science who have known only the pains of the fight, and always remained ignorant of the joys of victory.—*Dumas.*

Gun-cotton.—Professor Abel, who has so carefully investigated the properties of gun-cotton, thus sums up the peculiarities of this explosive substance:—"When inflamed, or raised to a temperature ranging between 137° and 150° centigrade, it burns with a bright flash and a large body of flame, unaccompanied by smoke, and leaves no appreciable residue. It is far more readily inflamed by powerful percussion than gunpowder; the compression of any particular portion of a mass of loose gun-cotton between rigid surfaces will prevent that part from burning when heat is applied. The products of combustion of gun-cotton redden litmus, and contain nitric oxide, hence they have a corossive action on gun-metal. In the open air it may be inflamed, when in actual contact with gunpowder, without igniting the latter; in a confined space (as in a shell, or the barrel of a gun) the almost instantaneous rapidity of its explosion produces effects which are highly destructive, as compared with those of gunpowder, while the projectile force exerted by it is comparatively small." For these reasons Professor Abel—who is chemist to the War Department—does not think we are yet in a position to use gun-cotton as a substitute for power.

The Magnetism of Iron Ships.—The following conclusions appear to be pretty well established, in respect to the deviation of the compass and the magnetism of iron ships, viz., that the magnetism of iron ships is distributed according to precise and well-determined laws; that a definite magnetic character is impressed on every iron ship while in the building slip, which is never afterward entirely lost; that a considerable reduction in the magnetism of an iron ship takes place on first changing her position after launching, but afterward that any permanent change in its direction or amount is a slow and gradual process; that the original magnetism of an iron ship is constantly subject to small fluctuations from change of position, arising from new magnetic inductions; and that the compass errors occasioned by the more permanent part of a ship's magnetism may be successfully compensated—this compensation equalizing the directive power of the compass-needle on the several courses on which the ship may be placed. That law is implanted in *all atoms* of nature, with a greater and less force, and is exhibited according to *the position* of those atoms—thus it pervades all nature is evident. Its action can be more plainly seen or read in iron than in any other inanimate matter. As it is seen in iron, so it must or can be seen in iron ships. Any one can prove this by a simple experiment with a bar of soft iron and a poised magnetic needle or compass. By holding the bar of iron perpendicular over the needle, they will find the iron will, with a force in proportion to the size and length of the bar, act as a magnet, and attract the "south" point of the needle, repelling the "north;" invert the bar and place it perpendicular under the needle, and you will have an *immediate* reverse action; place the needle in the middle of the bar (still perpendicular), and there is no force exhibited; lay the bar in a horizontal position, and it will "appear" to lose its force, the "polarity" of the bar is *then* in or through its diameter. Thus the action or exhibition of magnetism in the iron depends entirely on *its present position*, and has nothing to do with its former position, or how it has been. With a piece of steel it is different: *its atoms* being in a more compact position, its "polarity" may be set or fixed, yet its *position* must alter its force, but not to the same extent as iron. If the ship is built of steel, this theory will hold true: it would then be very important to know not only the *position* in which she had been built, but the latitude she was built in; yet an examination of the ship with a poised needle would show or explain. Thus *the cause* of a local attraction may be noticed *anywhere*. As that action is shown in iron, so it acts and can be seen or noticed in iron ships; hence it is not necessary to know how a ship *has been*, but what is *her present position*. Thus, "adjusting" iron ships in docks, and placing fixed magnets to counteract local attractions, cannot have the desired effect, as it (magnetism) pervades all nature, and cannot be counteracted, but can be known, and may thus be avoided.—*American Artizan.*

A Law of Combustion.—Numerous and careful experiments have developed the law that the heat generated by the burning of any substance is pretty nearly in proportion to the weight of oxygen with which the substance combines in burning. For instance, the combustion of one pound of hydrogen gas will raise the temperature of 33,808 lbs. of water one degree of the centigrade scale, while the burning of a pound of tin will raise the temperature of only 1,144 lbs. of water one degree. But the pound of hydrogen in burning, combines with eight pounds of oxygen, while the pound of tin combines with only about one fourth ($\frac{1}{4}$ths) of a pound of

oxygen. A simple calculation will show that the quantity of heat generated by the combination of a pound of oxygen is very nearly the same in both cases. A pound of oxygen in burning hydrogen will raise the temperature of 4,226 lbs. of water one degree, while in burning tin it will raise the temperature of 4,230 lbs. of water one degree. This law does not hold, however, in cases where the combustible in burning undergoes a change of form, from the gaseous to the solid, or from the solid to the gaseous state. For instance, carbon in burning to carbonic oxide is changed from the solid to the gaseous form, and in this case a pound of oxygen generates only 2,962 units of heat, while in burning this carbonic oxide into carbonic acid, where no change of form takes place, a pound of oxygen generates 4,258 units of heat. In burning zinc the oxygen is changed from the gaseous to the solid state, and in this case a pound of oxygen generates 5,285 units of heat. When either the combustible or the oxygen is changed from the solid to the gaseous form, a portion of the heat is absorbed, and the amount of sensible heat is diminished, but when the change is the opposite way the sensible heat is increased. Even where no change of form occurs in either of the combining elements, the amount of sensible heat developed may be modified by a change of volume; an increase of volume diminishing the sensible heat, and a contraction of volume adding to the heat set free. There are indications also that the law is further modified by influences which are not fully understood.

Specific Heat.—Different solids and liquids undergo different degrees of expansion, from the same quantity of heat; we have further to observe that equal bulks of different substances require the addition of different quantities of heat, to produce the same change of temperature. The heat entering in this manner into the composition of various substances, is called their specific heat, and may be thus conveniently illustrated:—Take a pint of water at 100°, and mix it with a pint at 50°, the thermometer will indicate the temperature of the mixture to be 75°, which is as might be expected, being the precise arithmetical mean; now mix a pint of mercury at 100°, with a pint of water at 40°, and it will be found that the resulting temperature is not the mean 70°, but 10° lower, viz., 60°, so that the quicksilver will lose 40°, whereas the water will only gain 20°; notwithstanding which, it is clear that the water has gained the whole heat that the quicksilver has lost; hence water has a greater capacity for heat than quicksilver, or it requires a larger quantity of heat to raise it to a given temperature. Again:—Take two similar glass bulbs, one containing water and the other mercury, and immerse them at the same time in hot water: it will be found that the mercury bulb is heated up to the temperature of the water, in half the time that the water bulb requires; and if the two bulbs, after having both attained the temperature of the water, be removed and exposed to the air, the mercury bulb will cool twice as rapidly as the other. All these experiments concur in proving that water has twice the capacity for heat that mercury possesses. What is termed the specific heat of water is not, however, as two to one. Since it is more convenient to express the capacities of different bodies with reference to weight than to measure, a pound of quicksilver at 40°, agitated with a pound of water at 156°, produces a temperature of 152°3: the water thus losing only 3°7 of temperature, and the mercury gaining 112°3. Now 3°7 : 112°3 :: 0·033 : 1; consequently if water be taken as the standard of comparison as unity, the specific heat of quicksilver must be called 0·033, or if, which is more convenient, the specific heat of water be taken as 1,000, then that of mercury will be 33.—*Noad's Lectures on Chemistry.*

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

1853. G. Lansdown, a method of providing a direct communication between any guard and any passenger in a railway train.

1858. J. Lang, certain improvements in apparatus for signalling on railways.

1868. W. Dicey, an improved means of communication between railway guards or other attendants and passengers in railway trains.

1869. A. Alexander, improvements in firing or discharging and exploding missiles under water, and in constructing such missiles.

1873. W. Anderson, improved apparatus applicable to the working of moving parts of railway trucks, and of the signals connected therewith, and of other instruments required to be operated in a predetermined order.

1906. E. Tattersall, improvements in effecting communication in railway trains between passengers and guard.

1924. M. Woodfield, improvements in apparatus for communicating between passengers and guards and between guards and engine drivers on railway trains.

1940. G. E. M. Gerard, improvements in apparatus for cutting sheets or bands of vulcanized india-rubber and other substances into threads.

1973.—P. A. J. Dujardin, improvements in electric telegraphs.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1787. Z. B. Smith, and W. L. Nelson, improvements in apparatus for signalling on railways.

1823. A. V. Newton, improvements in electro-telegraphic apparatus.—A communication.

PATENTS SEALED.

341. B. Todd, improvements in composition to be used to prevent the oxidation of iron, the fouling of ships' bottoms, and other submerged things, and also preserving wood from decay and worms.

PATENTS WHICH HAVE BECOME VOID.

1800. Sir W. O'S. Brooke, improvements in apparatus for suspending and insulating electric telegraph wires.

1819. R. Laing and G. H. Cossins, an improved mode of obtaining nitrous acid gas for making sulphuric acid.

NOTICES TO PROCEED.

821 J. Hunt, an improved instrument or "tell tale," for registering the time of arrival and departure of workpeople in houses of business and manufactories.

899. J. B. Thompson, improvements in electro-magnetic induction machines.

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

1994. H. Wilde, improvements in electro-magnetic telegraphs, and in apparatus connected therewith.—Dated 10th August, 1861.

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THE TELEGRAPHIC JOURNAL.

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FORCE AND FORM.

Contributed by B. O'M.

V.

It is considered that the ultimate particles or atoms, of which each simple substance is composed, were created of distinct and separate kinds, and that they are essentially distinct. If the ultimate particles of matter are hard and unalterable, then of course, this is a necessity; but with the atom just described it is not so. If all matter, of whatever kind be simply force in form, then the only essential differences will be, that of form, and this being essential to the simple atom, is essential to all other atoms of whatever degree, and also of the elements of matter in ultimates, and of all minerals, organic and animal matter; for that which is essential to the simple atom must be an essential to matter, however ultimated. We speak of the three kingdoms of nature as the mineral, vegetable, and animal, but really there are no such separate divisions in nature; convenient such divisions are, no doubt, as classifications for study; but as scientific facts, not true. One universal law binds all together. This is it:—Everything is what it is by virtue of its form.

This is not axiomatic, perhaps, in the ordinary acceptation, like these, "A thing cannot both be and not be at the same time," "The whole is equal to all its parts taken together," &c.; at least it is a universal proposition, and as such, if true, may be proved to be so; if not, disproved. Now mind, do not confound form with shape. Form is the *resultant* of internal potencies, not only as to balance, but as to intensity and rythm. Shape is the *result* of external circumstances. Internal potencies are two, polar and equatorial; but of intensity and rythm, infinite. External circumstances have no constant law, but are the effects of various laws. Let us see how the matter stands. As before, let us take the province of each sense and submit what it gives us to the solvent of reason, to try to find wherein its essence consists. We will take the sight first, as before. Colour and shape only belong to the sight, colour not being essential to matter it was not then touched; but shape only, shape being the particular of which form is the general: colour then remains. By means of light we have colour. Light is produced by the undulation of a very fine kind of matter called æther; by the way, how odd it is that people still continue to call light an imponderable substance, when it is now agreed on all hands that it is simply the motion of the æther; but the æther is matter, is it? Well, certainly, but the light is not the æther, but simply the motion of it; besides the æther does not belong specially to this earth, but is a universal sphere embracing all planets, suns, and comets; for light comes to us from the remotest star as well as from a tallow candle beside us. It is said that light is produced by the undulations of the æther; but this can hardly be; for undulations are reversed curves, which can result only from discontinuous and reversed force, and such a force can never arise from one source, or act from within: however, for the present we will leave that. Light, then, is produced by the internal motion of the atoms of the æther. If light come direct to us without refraction or reflection, it is colourless. If refracted, then according to the angle of refraction is the colour: whether red, yellow, or blue, or their intermediates. This has been called a separation of light into its compotent colours, as if three positive colours mixed together would make no colour at all. We have all heard of Lindley Murray's wonderful doctrine, that two negatives make an affirmative; but we have never heard or seen it stated, that three positives, when taken together, make nothing at all. Did you never go to a cram lecture, where the last discovery in science is shown to the wondering audience. There you might have seen this wonderful thing proved *a priori*. A disc of cardboard, painted with the spectrum proportions of red, yellow, and blue, fixed to a machine that it may be twirled round, so that the colours may be mixed to the eye, and you are told, that what you see is white; although you know very well, that it looks suspiciously like grey. O, but you know that is attributable to the crudeness of the colours used. It is a pity, that pure colours cannot be tried, that this assumption might be made a reality if possible. But if it were, what would it prove? Simply that colours have no real existence, which of course they have not, if light is simply motion, which hardly any one doubts now; the different degrees of refraction being mere modifications of that motion. If light come to us through vapour, as at sunset, we have the brightest red shading off into the most beautiful tints of orange, yellow, and apple-green, to the blue of the clear sky, and this by the modification of the motion, which produces colourless light; therefore the infinite varieties of tints observed in nature are all produced by modifications of the form of motion, which produces light; consequently form, and its modifications, internal and external, produce all visual impressions. Touch:—The properties of matter cognizable to the touch, not being generals, consequently not examined before, are—hard, soft, elastic, non-elastic, rough, smooth, and hot and cold. Hard and soft, and elastic and non-elastic, are modifications of resistance, or of the intensity, or balance of internal force, and not alterations of form. Rough and smooth are results of external shape; if from within, as in the husk of fruits, &c., then from internal form. If accidental, as from abrasions, &c., still the surface left will be according to the form of the ultimate elements of that substance, or from the intensity or balance of the forces which ultimate these forms. Hot and cold:—These properties cannot exist without modifying the form of the substance wherein they are, which modifications are called expansion and contraction; but these may not extend to the absolute change of the internal form, they may be simply modification of tension of force; but they may be modifications of form: as in water becoming steam or ice; therefore form and its modification, together with intensity and balance of force, produce all the impressions of touch. But intensity and balance of force, if pushed beyond a certain limit, produce alteration of internal form. Besides what is here noticed, form and resistance, or general properties referable to touch, which were noticed previously, are also included in the present conclusion.

Smell.—I will quote from my previous induction of the objects of the senses, to save the trouble of reference: "There can be no smell without effluvia; but what is effluvia? Philosophers say they are the finest and most volatile parts of matter, and, though they cannot be perceived by sight or touch, yet reason shows that without form and resistance they are not even conceivable." Therefore difference of scent means change of the form of such effluvia, and difference of intensity of scent means difference of intensity of the forces ultimating such forms.

Taste.—Taste is a finer touch, and that the tongue may feel with its internal parts, a natural solvent of all things to be tasted is poured out, that they may penetrate its interiors, so that it may feel the interiors of things with its interiors; but the lips and tongue have a more exquisite sense of touch proper than the fingers, and are used as organs of touch by children. The range of sensations derived from our tongue and palate is far greater than that derived from our touch proper, yet, as far as our sensations derived by touch from forms go, their names are given to the sensations of taste, as rough, smooth, hot, cold, flat, sharp, &c. Besides, in all cases where taste has been analysed the various tastes have been attributed to the ultimate particles of the matter tasted: as sharp, sour, acrid, have been attributed to angular particles; but sweet, bland, smooth tastes have been attributed to globular particles or a mixture of angular and globular. Whether this be so or not it does not much matter; but it shows clearly that taste and touch are considered but different degrees of the same sense. The taste supplements the touch. The touch feels the externals of things; but the taste feels their internals. It is superior to the touch in delicacy, even as to the proper province of touch, as well as extending into a region where ordinary touch cannot reach.

Hearing.—"Hearing is the effect of the tremor or gyration of the air;" therefore the different sounds heard from the different modifications of the forms of the semotions of the atmosphere. The modifications from grave to acute arise from the modification of form; and the gradations from loud to gentle sounds arise from variations of intensity of the force.

Each thing then is to us what it is by virtue of its form, and its range of potency in that form, by virtue of the intensity of the force which ultimates that form. If this be true, then all nature is organic, and there is no such thing as dead matter; but all material things are organs of life, from a stone up to man. One grand life pervades the whole in different degrees and series, according to each form of reception.

The next question that arises is, out of this one simple atom how are the infinite forms in Nature to be built up?

In the Newtonian theory there must be at least fifty solid atoms to begin the world with: one for each simple substance. That would make a considerable series, if arranged according to the laws of permutation; but things will not always be arranged in that way; there must be some affinity between them, or they will not unite. It is to be borne in mind that our atom is not an element; but each of these fifty is not only an atom but an element; and, by the way, an element can hardly be the simplest entity in Nature; at least, in the succeeding series of Nature there is no such grade of advance as that.

As stated above, all atoms, whether simple or compound, must be of similar nature; for they are all compounds of that first and simplest form of existence. According to the essence of this atom, as described and figured, two or more of these may unite polarwise, and, as it were, coalesce; but that would be only a concreting of simple atoms, it would not be an ascent to a new degree or form of atom. It is simply a concrete form, and not a discrete, or new form. To produce the next new form, or second atom, must be by the aggregation of the first atoms polarwise, and in a vortical, like to the fluxion of the first atom; so that each shall be joined to each by unlike poles in a continuous unending series, which must, of necessity, fall into the vortical form, else it would have no stability. You can conceive of it as a ring, like Faraday's ring magnet, or, perhaps what would be nearer, a ring of magnets, where the whole minus each in turn would form an armature to each; but you can also clearly see there would be no stability in this form; it would infallibly be disrupted by external force. Not so with the vortical, into which the atom naturally tends.

These simple atoms so aggregated would have, of necessity, somewhat changed their nature. Our suppositious ring of magnets will serve to explain this matter to us. Each atom being joined to the others next to it in the vertical series, the circumferential gyres of each cannot possibly exist; for the polar fluxion of each would join on to the polar fluxions of those next to it, and so complete the vortical fluxion of the series without return circumferential gyre; as there would be none needed or possible. Similarly would our ring of magnets have no external lines of force, if they perfectly armed each other. But let us state, generally, the fluxion of the magnetic force, so that this may be seen more clearly.

In a symmetrical magnet the internal and external lines of force are equal in amount though not in density; but if this magnet be bent round as a horseshoe and simply armed with a piece of iron, the external lines of force are nearly all removed, and if it were perfectly armed, there would be no external lines, the whole would pass through the armature to complete the circuit. Now this is just what must take place in our atom of the second order. The first atom is a simple vortical fluxion. The second is a spiral vortical, and the third will be a compound spiral vortical, and so on, according to each discrete degree. The first atom must be of infinite elasticity and mobility, from the very nature of its fluxion. The second will be less elastic, and less mobile, and comparatively more fixed and hard, and so on in each order of atom as they become more finited: and still more so of the elements.

THE CONSTRUCTION OF AN OVERLAND LINE BETWEEN BAGDAD AND FAO.

(From an Occasional Correspondent.)

Bagdad, 6th July, 1864.

You are, I have no doubt, already aware that our operations in Mesopotamia, as regards the construction of the land line from Bagdad to Fao, at the head of the Persian Gulf (the point where the cable is landed), have been very much delayed and obstructed by the revolt of the Montefic Arab tribe against the Turkish Government; the consequence is that we have only been able to construct the line from either end, viz., Bagdad and Fao. From Bagdad the line south is completed as far as Dewanich, a distance of 105 miles, with an intermediate station at Hilleh (Babylon); and from Fao northwards the line is completed to Gurneh (the confluence of the Tigris and Euphrates), a distance of about 105 miles, with an intermediate station at Bussorah, leaving a break in the chain of communication of about 180 miles, for which distance the line of telegraph will follow pretty closely the banks of the Euphrates, as soon as the Montefic rebels make peace with the Turkish Government.

In April a new sheikh was appointed by the Turkish Government in place of the rebel sheikh. After some fighting in Mesopotamia between the two parties, the rebel crossed to the right or west bank of the Euphrates, and was said to have gone away for good into the desert with a few of his followers, and the Turkish authorities were fain to believe that the matter was quite settled, and the telegraphic operations could be commenced at once; but, before the telegraph stores could be got on the ground, the rebel again makes his appearance on the west bank of the Euphrates with a strong force of Arabs, and the country is again very unsettled. But up to this time (with one exception, when a few insulators were broken) the rebels have not interfered with the portion of the line already constructed, which is a proof that their ill will does not extend to that, for with the greatest ease they could destroy the largest portion, and no one to say them nay. I only hope that the policy of the Turks may so far settle the matter as to allow the line to be finished next cold weather. But even with this break of 180 miles, with arrangements made by Colonel Kemball, Her Majesty's Consul-General at Bagdad, for Arab messengers to run between Bussorah and Dewanich, messages have been received at Bagdad, from India, in four and a-half days, and had the Turkish stations between Bagdad and Constantinople been supplied with European clerks, and that line in good working order, telegrams could easily have been sent through from India to London regularly in six or seven days, but up to this time there are no signallers for the stations.

It is very gratifying to know that the Gulf cable continues to work without interruption. Next month is the hottest in the Gulf; if the insulation keeps up during August I have no doubt, from what I know personally of the Gulf, that it will go on satisfactorily for years, as far as the cable itself is concerned. The difficulty in this part of the world is the land lines, and not the cables; but in Asia, I think, things are very often reversed; for instance, the Asiatic covers his head and uncovers his feet, while the European does just the reverse; the Asiatic writes from right to left, the European just the reverse; and so it appears in telegraph matters.

The land line from Bagdad to the Persian frontier, at Khannikeen, is completed (one wire), and the English staff are progressing with the line in Persia (one wire), but not so quickly as they could wish; they have a great deal of trouble to get poles, &c., which have to be supplied by the Persian Government. It was hoped that the line would be ready for work early in July, but I am afraid such will not be the case. The Persian line joins the Turkish line at Khannikeen, passes through Hamadan to Teheran, thence through Ispahan and Shiraz, to Bushire, where there is a cable station.

THE VOLTA-INDUCTOR OF SIEMENS, HALSKE, & CO.

THE core of this coil consists of varnished iron wires, 13 millimetres thick and 95 centimetres long, cemented into one cylinder of 60 mm. diameter. Round this core are coiled parallel, in two layers, two copper wires of 25 mm. thickness. Core and wire weigh 35 lbs., and are inserted into an ebonite (highly vulcanized india-rubber) tube of 26 mm. thickness at the ends, and 12 mm. in the middle. To this tube are fastened equidistantly 150 thin discs of the same material, dividing the whole length into as many compartments, each of which is filled up with thin copper wire, 0·14 mm. thick, covered with silk, and saturated with a suitable varnish. The total length of this secondary wire is 129,000 metres, making 299,000 turns round the tube; weight about 58 lbs. The resistance of the secondary wire is 162,000 Siemens' mercury units at the freezing point, and that of each of the primary wires 0·32. The reason the insulating tube is left thinner at the middle is, firstly, because the tension there is smaller under normal conditions, even = to O, and increases towards the ends, where the danger of the flying of a spark towards the core only can be diminished in proportion to the thickness of the insulating material, but principally because those layers of the secondary coil closest to the tube form a Leyden jar with the primary coil. The capacity of this double jar must be as small as possible, as otherwise the tension at the ends of a secondary wire with the iron core would considerably diminish the length of spark. No tension being in the middle, no destructive jar actions can take place. The most suitable form of insulating tube, therefore, is the parabolic section.

The primary wires should enter and leave the apparatus at the same end of the coil, and the battery be thus put in circuit so as to make the positive electricity of the secondary coil appear at the closed end of the coil, and the negative where the primary wires enter, for the spark always flies from the positive pole, and its striking distance is longer. If we allow the positive pole to be at the open end of the apparatus, the spark would, at long distances, prefer flying to the primary wire and coil, to the destruction of the instrument. The proper connexion is easiest ascertained by putting a commutator into circuit with one or two elements urging the spark at short lengths, and reversing the commutator if it should start from the long pole; or, if the operator be not quick-sighted enough, whichever connexion produces the longest spark is sure to be the right one.

The hollow disc *should always be connected with the negative* pole, for it then increases the length of spark, but diminishes it when put to the positive pole. Its action is twofold: first, by acting indirectly on the positive *point*, it increases the tension of the electricity starting from that point, and consequently the length of spark, but principally through its jar action with the walls of the room; it decreases the tension of the negative pole (incompletely conducts it off), by which means increased tension of the positive pole, and consequently length of spark is gained. It (the hollow disc) may be dispensed with by putting the pole to earth altogether, but this is not desirable at long lengths of sparks, for the too greatly increased tension of the positive pole would facilitate the passage of the spark to the core or into the air, and thus destroy the apparatus. Connecting a Leyden jar of sufficient thickness and very *slight capacity* between negative pole and earth produces nearly the same effect as the hollow disc. To produce a brilliant spark the inner coating of a Leyden jar of thick glass should be connected to the positive pole, the outer to the negative. By closely approaching the poles to one another a quick succession of brilliant discharges will take place accompanied by a shrill sound.

The condenser consists of tinfoil separated by varnished paper, each being 15,000 centimetres super. With Siemens' construction (differing from that of Ruhmkorff) it is of little influence as regards length of spark; it considerably diminishes the strength of the primary spark, and the flying about of the alcohol of their make-and-break apparatus.

This apparatus is constructed so as to make a *long contact* and a *short break*, and is put to work slowly swinging to and fro. The alcohol is poured over the platinum, amalgamating the contact-cups, and should be renewed when blackened by the oxide of mercury. The amalgam (silver amalgam will do as well) should be thickly fluid and free from oxide. One contact-cup serves for the self-acting and break arrangement, the other for the primary current. Before use the battery should be well cleaned and freshly amalgamated. The nitric acid must be strong, and, if necessary, one-third concentrated added to the mercantile, and should be filled only a quarter of an hour before the experiment. The deciding experiment, with battery *in good condition*, gave—

1	element length of spark	21 centimetres
2	" "	8·9 "
3	" "	47·5 "
4	" "	51 "
5	" "	55 "
6	" "	58 "

Using the primary wires parallel. With more elements, however, they might be joined more profitably into one length. It would be dangerous to attempt to produce sparks more than two feet in length. Sparks are seen flying off all pole-faces in the dark. This seems to be the approaching maximum. For experiments before the public, sparks between two balls (without disc), with six elements, at about 18″ or 20″ in length, show best.

DE LA RIVE ON THE PROPAGATION OF ELECTRICITY IN RAREFIED ELASTIC MEDIA.

IN the last part of the *Mémoires de la Société de Physique et d'Histoire Naturelle de Genève* which has reached this country there is a paper by this distinguished electrician.

M. De la Rive, after fully describing the apparatus employed, remarks that, in studying the general phenomena which the transmission of electricity through rarefied gases presented, it was found that, although when the circuit was composed of good conductors the rapid reversal of the current caused no deviation of the galvanometer; on the contrary, the circuit was interrupted when having to pass through a bad conductor, such as a rarefied gas—the direct current, under such circumstances, being alone transmitted, so that the direction of the induced current which traversed the gas was the same as the inducing one.

The pressure at which a discharge of a given intensity commences to traverse a gas varies not only with the gas and its degree of rarefaction, but also with the dimensions and form of the vacuum tube employed. Also, *the discharge does not pass immediately after the electrodes are placed in connection with the coil.* A certain time is required, which increases with the resistance, from whatever cause that resistance may arise. Thus, in a tube 30 to 50 centimètres long, several minutes are required, however rarefied the gas may be. When once the current has passed, however, the passage becomes more easy, and if the density of the gas be increased, it does not divert the passage of the current. The professor thinks, from these and other facts which he mentions, that the gaseous matter opposes a certain *inertia* to affect the peculiar disposition which the passage of the current induces, and which is determined by the tension preceding transmission.

Some numerical results are given to show the general truth of these observations, and the paper proceeds to deal at some length with the well-known stratification of the electric spark. It is remarked that the transmission of electricity through the tubes determines a movement in the particles of the gas, and a movement which seems to be an impulse emanating from the negative electrode. De la Rive asks whether this can be attributed to the static electricity with which the molecules are charged, and which augments their inherent repulsion? The luminous aurora which surrounds the negative electrode proves that at equal tensions the

negative electricity issues more readily than the positive from the metallic electrode; therefore the portion of the surrounding medium nearest the negative electrode should be more charged with static (negative) electricity than the part of the rarefied gas near to the positive electrode. It is not, therefore, surprising that the molecular repulsion of the gas and its consequent rarefaction are greater in the neighbourhood of the former electrode. Why, however, negative electricity diffuses itself more readily than positive, under like conditions, is still a mystery.

The next section of M. De la Rive's memoir deals with the practical phenomena presented by the stratification, which he has studied in a new manner in order more effectually to observe the resistance to the transmission of the electricity in the different portions of the tube. He uses two small discs of platinum 7 millimètres in diameter, and each fixed by a point in their circumference to the extremity of a platinum wire in a glass tube, in such a manner that the discs are preserved in a state of parallelism at a distance of 3 centimètres. The two discs are firmly held together and perfectly insulated, except as far as regards the wires soldered to their circumference, the extremities of which can be placed one by one in communication with that of the galvanometer. The apparatus is so arranged that the two discs of platinum can be introduced in the stratification, either cutting it transversely or with their centres situated in its axis. They can thus be introduced in any part of the stratification, take up the intensity of that part, which will be smaller as the conductibility of the interval from the derivation of the current is greater, and thus measure by the deflection of the needle of the galvanometer the exact intensity of the part examined.

The following table will conveniently show the result of an experiment of this kind in nitrogen and atmospheric air:—

INTENSITY OF DERIVED CURRENT.

Pressure.	Discs near Positive Electrode.	Discs near Negative Electrode.
6 millimètres	70°	18°
4 „	40	8
2 „	18	3

and in hydrogen—

INTENSITY OF DERIVED CURRENT.

Pressure.	Discs near Positive Electrode.	Discs near Negative Electrode.
15 millimètres	90°	90°
6 „	82	65
4 „	52	2

It thus appears that the intensity of the derived current diminishes with the pressure; but the diminution of the derived current, and consequently of the resistance, is much greater when the discs are placed in the darker portion near the negative electrode.

M. De la Rive, while dealing with this subject, points out the enormous luminous and calorific power of electricity, by means of which hydrogen reduced to a pressure of 1·5 millimètres becomes not only luminous, but heated to such a degree by the passage of electricity, that in two minutes the temperature of a thermometer with a cylindrical reservoir is raised some three degrees. An analogy is also insisted upon between this finely-divided matter and that of comets.

The last part of this memoir, which our space compels us to analyse so imperfectly, deals with the influence of magnetism on the various stratificative phenomena dealt with in the other parts of the paper.

M. De la Rive's researches on these subjects comprise two series of experiments: the first in which the electro-magnet is placed outside the rarefied gas; the second in which the soft-iron magnet is situated in the rarefied gas itself. The experiments of the latter class have been made by the apparatus recently described in these pages as having been exhibited at the Royal Society soirée. Many elaborate series of experiments made by both apparatus are described; all the phenomena observed show, in a very striking manner, as M. De la Rive points out in conclusion, the molecular differences which the various media, even at an extreme degree of rarefaction, present among themselves. Thus, in hydrogen, although this gas is a very good conductor, the electric jets can only obey with great difficulty the action of the magnet, possibly on account of the very small density of the gas.

In air and nitrogen the matter is very different, and more altered still when the gases are mixed with aqueous vapour. The singular property which the jet has of subdividing itself into several small distinct ones, instead of disappearing under the magnetic influence when the medium contains a greater or less quantity of vapour, would seem to indicate that there is more cohesion in the vapour than in the gases properly so called, if, indeed, one can employ the term cohesion when the particles are so incoherent. There remains, however, a question whether this division into jets be an optical illusion due to the very rapid succession of jets not simultaneously issuing from different points.

M. De la Rive concludes this admirable and very suggestive addition to our electrical knowledge with the following remarks:— "It is evident that the study of the stratification of the electric spark, and of the action of the magnet on the discharges in different gaseous media, shows in these media differences which can only arise from a difference in their molecular constitution. Density particularly would seem to have a great influence on this class of phenomena, since we see hydrogen manifesting them in such a feeble degree, while aqueous vapour, and especially the vapours of alcohol and ether, presents us with them in such a remarkable manner. The constitution of elastic fluids, which more or less resists the transmission of electricity, doubtless plays a part. It is not, therefore, impossible that we shall be able, in a more detailed and profound study of these phenomena, and especially of those which relate to the action of the magnet, to find a means of obtaining some new facts relating to the physical properties of bodies, and the manner in which electricity itself is propagated in them."

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

III.

A.D. 1786.—Cassini, in 1786, discovered the annual periodical variation of the magnetic needle. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 87.)

A.D. 1786, 1787.—Coulomb, in 1786 and 1787, established the law that magnetic force was really in the inverse duplicate ratio of the distances, by his Balance of Torsion, and by the method of oscillations. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, pp. 742, 743; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 33-38; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 180-183, and 533-542.)

A.D. 1792.—The Rev. A. Bennet, F.R.S., in 1792, used a magnetic needle, suspended by a spider's thread, as a magnetometer. (See *Philosophical Transactions*, 1792, p. 86; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 105, 106.)

A.D. 1802.—Coulomb, in 1802, endeavoured to determine the question of a universal magnetism, and found all bodies that were tried finally settle in the direction of the straight line joining the poles, the needles of the various substances being suspended between opposite poles and in the same straight line with the magnet's axes. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 56.)

A.D. 1804.—Messrs. Gay Lussac and Biot, in the year 1804, "undertook, at the desire of the French Government, an aerostatic voyage, expressly for the purpose of ascertaining whether the magnetic force experiences any perceptible diminution at considerable elevations above the surface of the earth." The result of their experiments was that the magnetic force experiences no appreciable diminution at a height of 13,124 feet above the surface of the earth. In this case the effect of the diminution of temperature on the needle was not taken into account. (See *Library of Useful Knowledge*, Magnetism, p. 89.)

A.D. 1806, 1807.—Humbolt, in 1806 and 1807, observed magnetic storms at Berlin. (See Sir W. Snow Harris' *Rudimentary Magnetism* Part III., p. 103.)

A.D. 1809.—Professor Krafft, of St. Petersburg, in 1809, propounded the following law of terrestrial magnetism:—"If we suppose a circle circumscribed about the earth, having the two extremities of the magnetic axis for its poles, and if we consider this circle as a magnetic equator, the tangent of the dip of the needle, in any magnetic latitude, will be equal to double the tangent of this latitude." (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 7.)

A.D. 1813.—Colonel Beaufoy employed a very perfect form of variation of compass. This arrangement is described in the "Annals of Philosophy" for August, 1813; it consists of a telescope to determine the true meridian by astronomical observation, underneath the axis of which is a magnetic needle whose position is

alterable so as to show the angular deviation of the needle from the true meridian. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 150-152; also *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, pp. 766, 767.)

A.D. 1813.—Morichini, in 1813, magnetized a needle by means of the violet ray of the spectrum. (See *Library of Useful Knowledge*, Electro-magnetism, p. 97; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 69.)

A.D. 1817.—Mr. Westcott explained his magnetic guard for needle pointers before the Committee of Mechanics of the Society of Arts, on March 27, 1817. This instrument consisted of "a number of bar magnets, smeared with oil, placed in a frame behind the grindstone." (See *Transactions of the Society of Arts*, 1824, Vol. XLII., pp. 165, 166.)

A.D. 1817.—Professor Hansteen, of Christiana, in 1817, confirmed the law that magnetic force is inversely as the squares of the distances, by the action of the pole of a magnet upon a pivoted needle mounted as in the declination magnetometer. Professor Hansteen, in connection with M. Morlet, determined the position of the nodes of the terrestrial magnetic equator. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part. III., pp. 38, 39; also *Encyclopædia Britannica*, art. Magnetism, p. 57.)

A.D. 1817.—Professor Barlow, of Woolwich, commenced a series of experiments on the influence of spherical and other masses of iron on the compass needle, soon after the appearance of Professor Hansteen's work on the Magnetism of the Earth in 1817, and found the existence of a plane of no deviation of the needle at right angles to the direction of the dipping needle, and other laws of magnetic force. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, pp. 743 and 775; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 69-76.)

A.D. 1818.—Mr. George Fisher, in 1818, found that the rate of going of chronometers is influenced by the proximity of a mass of iron. (See *Library of Useful Knowledge*, Magnetism, p. 68.)

A.D. 1820.—Sir David Brewster, in 1820, remarked the connection between the terrestrial magnetic poles and those of maximum cold. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 11; also *Edinburgh Philosophical Transactions*, 1820.)

A.D. 1820.—Professor Barlow, in 1820, applied his correction plates to the "Leven," "Conway," and "Barracouta," to prevent local magnetic attraction. (See *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, p. 799; also *Transactions of the Society of Arts*, 1821, Vol. XXXIX., pp. 76-100.)

A.D. 1821.—Captain Kater, in 1821, found that shear steel is capable of receiving the greatest magnetic force, and that the pierced rhombus is the best form for a compass needle. He found that the directive force depends on the mass of the needle when magnetized to saturation. The method of hardening the needle preferred by Captain Kater is to harden it entirely throughout, and then soften it in the middle. (See *Library of Useful Knowledge*, Magnetism, pp. 57, 58; also *Encyclopædia Britannica*, art. Magnetism, p. 77; also *Encyclopædia Metropolitana*, Vol. III., art. Magnetism pp. 754, 755, and 770-773.)

A.D. 1821.—Mr. J. H. Abraham, of Sheffield, 1821, invented a magnetic guard to protect persons employed in pointing needles and other branches of dry grinding. According to one arrangement, a frame of bar magnets surrounds the operator's mouth; another arrangement consists in placing bar magnets just above the needles whilst they are being pointed; in the arrangement for dry-grinding cutlery, &c., the magnets are placed radially or longitudinally (or both ways) inside a hood near the point of grinding. The large gold medal of the Society of Arts was awarded to Mr. Abraham for this invention. (See *Transactions of the Society of Arts*, 1823, Vol. XL., pp. 135-150.)

A.D. 1822.—Lieutenant Littlewort, R.N., in 1822, received the large silver medal of the the Society of Arts for an improved ship's compass. This compass may be used either as a hanging compass, a steering compass, or an azimuth compass; for the latter purpose the suspending handle may be inverted and made to support the compass in a box (the said box being moveable about a centre), the card has a graduated silver circle, and moveable sights and a stop are annexed. (See *Transactions of the Society of Arts*, 1823, Vol. XL., pp. 70-72.)

A.D. 1823.—Professor Barlow, in 1823, proposed to render the diurnal variation of the needle more distinctly marked, by deflecting it from the magnetic meridian by means of a permanent magnet. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 152, 153.)

A.D. 1824.—Arago, in 1824, found that various substances (metallic substances more especially) have an influence on the oscillations of the magnetic needle. (See *Library of Useful Knowledge*, Magnetism, p. 91.)

A.D. 1825.—Mary Somerville, in the summer of 1825, magnetized a sewing needle by exposing one half to the violet rays of the spectrum; in two hours the exposed end had the properties of a north pole. (See *Library of Useful Knowledge*, Electro-magnetism, p. 97.)

A.D. 1825.—Mr. Christie, about 1825, proved experimentally that heat diminishes magnetic force. (See *Library of Useful Knowledge*, Magnetism, p. 13.)

A.D. 1829.—M. Kupffer, in 1829, observed the diminution of the magnetic force with the height, at the summit of Mount Elbrouz in the Caucasus. (See De la Rive's *Treatise on Electricity*, Vol. III., p. 242; also *Library of Useful Knowledge*, Magnetism, p. 89.)

A.D. 1829.—De la Rive, in 1829, observed a diminution of inclination of the needle at the Hospice of the Great St. Bernard. (See De la Rive's *Treatise on Electricity*, Vol. III., p. 242.)

A.D. 1830.—Haldat, in 1830, produced magnetism by the friction of hard bodies. He also proved that magnetic figures might be formed by tracing them upon a steel plate with a magnetic pole; they are rendered visible by sifting filings of steel upon them. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, pp. 13, 14.)

A.D. 1830.—Quetlet, in 1830, made experiments relating to "the successive degrees of magnetic force which a steel needle receives during the multiple frictions which are employed to magnetize it." (See *Encyclopædia Britannica*, 8th edition, art, Magnetism, p. 14.)

A.D. 1831.—Dr. Roget, in 1831, published an account of a mechanical instrument for generating magnetic curves. (See *Journal of the Royal Institution*, February, 1831; also Leslie's *Geometrical Analysis*, p. 399; also *Library of Useful Knowledge*, Magnetism, pp. 19-22; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 66-69; also *Encyclopædia Metropolitana*, Vol. III., art. Magnetism, pp. 793-795.)

A.D 1831.—Sir W. Snow Harris, in 1831, invented a mariners' compass consisting of the following parts:—A light bar-edged magnet with a central cap, the said magnet being hardened and tempered throughout. Small sliders of silver compensate for the dip, the magnet having been poised horizontally before magnetization. This card consists of painted talc, and has a cross-bar of brass, with adjustable sliders. The point of suspension proceeds from a double curved bar fixed as a diameter to a dense ring of copper, so as to take advantage of the ring's "magneto-electrical" restraining force in preventing the oscillations of the compass card. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 149.)

A.D. 1831.—Sir W. Snow Harris first employed the bifilar suspension for needle magnetometers in 1831. (See *British Association Reports*, Vol. IV., p. 17; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 120.)

A.D. 1831.—Sir W. Snow Harris invented his hydrostatic magnetometer about the year 1831. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 35, 115.)

A.D. 1831.—Sir W. Snow Harris used a modification of the scale-beam magnetometer about the year 1831. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., p. 35.)

A.D. 1831.—Professor Barlow, in 1831, coiled a hollow wooden globe with copper wire placed in the parallels of latitude. On an electric current being transmitted through this coil, "a magnetic needle suspended above the globe, and neutralized from the influence of the earth's magnetism, exhibited all the phenomena of the dipping and variation needles, according to its positions with regard to the wooden globe." It is inferred from this experiment that the earth may "be considered as only transiently magnetic by induction, and not a real magnet." (See *Encyclopædia Britannica*, art. Magnetism, p. 64, 65; also Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 120-122; also Mary Somerville's *Connexion of the Physical Sciences*, p. 366.)

A.D. 1832.—Pouillet described the astatic magnetic needle in his "Elements of Physique," Paris, 1832. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 90.)

A.D. 1832.—Captain Milne, R.N., in 1832, proposed a corrected compass card to obviate the errors incidental to local attraction. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 171.)

A.D. 1832.—The Rev. Dr. Scoresby, in 1832, measured distances by the action of a magnet on the compass needle. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., p. 185; also *Edinburgh New Philosophical Journal*, April, 1832.)

A.D. 1835.—Mr. Fox, in 1835, measured the variation, dip, and magnetic intensity of the magnetic needle by means of his "dipping needle deflector." (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, pp. 87-89.)

A.D. 1836.—Gauss, in 1836 and 1837, employed the unifilar and bifilar magnetometers in connection with a divided scale and theodolite, to observe the variations of terrestrial magnetism. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 212-217, also p. 308.)

A.D. 1838.—Professor Airy, in 1838, proposed to correct ships' compasses, and to obviate the effects of local attraction upon them, by means of magnets. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 174-177; also *Transactions of the Royal Society*, 1839.)

A.D. 1838-1839-1840.—The "Admiralty compass," resulting from an inquiry instituted 1838-40, consists of four of Scoresby's compound magnetic bars, card of mica, copper compass bowl, and spare cards and electro-gilt steel pivots. (See Sir W. Snow Harris' *Rudimentary Magnetism*, Part III., pp. 145, 106.)

A.D. 1839, 1840.—Dr. Kreil, in 1839 and 1840, at Prague, made some noteworthy observations on the influence of the moon on the magnetic elements of the earth. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 19.)

A.D. 1842.—Dr. Lloyd, in 1842, proposed an indirect method of measuring the inclination of the compass and its changes. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 87.)

A.D. 1842.—M. Plantamour, having observed the variations of the magnetic elements at Geneva during the years 1842, 1843, points out that the position of the moon with respect to the earth is not without influence upon the movements of the magnetized needle. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 261, 262.)

A.D. 1844.—Baron Reichenbach, in 1844, made researches respecting the action of the magnet upon the human frame, more especially upon certain people denominated "sensitives." These people, in an absolutely dark room, uniformly perceived luminous emanations of various tints at different parts of the magnet. The luminosity of the magnetic emanation was confirmed by the fact of its image being able to be fixed on a daguerreotype plate. Other effects of magnets on the human frame are described. (See Reichenbach's *Researches on Magnetism, Electricity, Heat, Light, Crystallization, and Chemical Attraction in their relation to Vital Force*. Translated and edited by Dr. Gregory, London, 1846.)

A.D. 1845.—Faraday, in 1845, discovered that when a ray of polarised light is made to pass through a piece of heavy glass (consisting of silico-borate of lead) placed near a magnetic pole, in such a manner that the lines of magnetic force shall pass through the glass in the direction of the ray, the ray rotates according to the following law:—"If a magnetic line of force be *going from* a north pole or *coming from* a south pole along the path of a polarized ray coming to the observer, it will rotate that ray to the right hand, or if such a line of force be coming from a north pole or going from a south pole, it will rotate such a ray to the *left hand*." (See *Philosophical Transactions*, 1846, Vol. I., p. 1; also Gmelin's *Handbook of Chemistry*, Vol. I., pp. 168, 169; also Sir W. Snow Harris' *Rudimentary Magnetism*, Parts I. and II., pp. 71-73.)

A.D. 1846.—Mr. Wartmann, about the year 1846, "announced that a piece of rock salt, placed in the route of polarized rays of heat, determines the rotation of the plane of polarization, if a powerful electro-magnet is made to act upon it." (See De la Rive's *Treatise on Electricity*, Vol I., p. 525.)

A.D. 1846.—Faraday, in 1846, propounded the laws of diamagnetism. According to this discovery, certain bodies are found to place themselves at right angles to the straight line joining the poles of a magnet, when freely suspended so as to be capable of motion in all directions round a centre; this position is called "equatorial," in contradistinction to that assumed by magnetic bodies, such as iron, which are said to take up an "axial" direction when under magnetic influence. In these investigations the most powerful magnetic bodies were found to be iron, nickel, cobalt, manganese, and chromium; the most powerful diamagnetic bodies were found to be bismuth, phosphorus, antimony, heavy glass, and zinc. (See *Athenæum*, January 31, 1846; *Practical Mechanic and Engineers' Magazine*, February, 1846, pp. 117, 118.)

A.D. 1847.—Professor Bancalari, in 1847, published his researches on the diamagnetism of flames and gases. (See Noad's *Manual of Electricity*, pp. 842-844.)

A.D. 1847.—Brooke, in 1847, invented the photographic system of registering the variations of terrestrial magnetism, and subsequently put it into practice at Greenwich. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 217-222, also p. 308.)

A.D. 1848.—Faraday, in 1848, discovered magneto-crystalline force. The line in which this directive force is exerted is called the "magne-crystalline line"; this line is found to have relation to the crystallization and optic axes of bodies in which its presence is manifested. MM. Plucker and Beer also made experiments showing the nature of this force. (See *Athenæum*, No. 1103, p. 1266; also Gmelin's *Handbook of Chemistry*, Vol I., pp. 514-519; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 482-497.)

A.D. 1850.—MM. Tyndall and Knoblauch, in 1850, succeeded in showing the relation of the magneto-crystalline force, or manifestation of force, to magnetic and diamagnetic force. They found "that the magnetic properties of the optical axis are connected with a general principle, namely, that when the molecular constitution of any body is such that the particles of which it is formed are nearer to each other, according to a certain direction, than in the rest of the mass, this direction, all other circumstances remaining the same, is that in which the forces which are acting upon the body manifest their action with the greatest energy; so that the line which represents this direction places itself axially or equatorially, according as the substance is magnetic or diamagnetic." (See *Philosophical Transactions*, 1850, Vol. XXXVII., p. 1; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 490-497.)

EXPERIMENTAL ELECTRO-PLATING.

(By a Student.)

Electro-plating is based on exactly the same principles as electro-typing in copper; but, on account of the greater expense of the materials used, a mould is seldom, if ever, copied in solid silver, as is the case with copper; but, in order to give it the appearance of being executed in silver, a thin deposit of that metal is produced on its surface, by the process which we will now describe. The silver solutions may be prepared in either of the two following ways, we recommend the latter:—1. Dissolve any small silver coin, such as a sixpenny piece, in aquafortis (nitric acid); the solution will have a blueish tinge, owing to the copper contained in the coin. Now add to this solution another solution of common salt, in water; this will throw down a precipitate of chloride of silver. When it has settled at the bottom of the glass, pour off the solution from above it, and fill the glass with water; let it again settle down, and then again pour off the water. This operation, which is called "washing the precipitate," must be repeated two or three times. Now make a solution of cyanide of potassium, of the strength of about half-an-ounce of that substance to one pint of water, and throw into it the white precipitate; in a few minutes it will all be dissolved, and then the solution is ready for use. 2. Dissolve an ounce of the crystals of nitrate of silver in about two ounces of pure distilled water, and add to it a solution of caustic potash until no more precipitate is thrown down; wash this precipitate as directed in the first instance, and then dissolve it in a similar solution of cyanide; this solution being carefully prepared, the rest of the arrangements are very easily set up. On account of the costly nature of the solutions used, it is better to put them for use into glass vessels. Instead of the wooden decomposing cell recommended for the copper process, a large tumbler, or a finger glass, are among the best things which the student can obtain for the purpose, without going to any great expense about it. A couple of brass rods can be laid over it.

The same battery may be used for the plating as is used for the copper process, and the power may be about the same, or rather less. The student will probably find it more convenient to silver his moulds one at a time, in which case a piece of wire may be attached to the back of one of them, by twisting round any prominent part near the edge, and the other end of the same wire may be twisted round the top of the zinc plate of the battery. A piece of silver foil, of about the same size as the mould to be silvered, is now to be connected, in a similar manner, with the copper plate of the battery. The silver plate and the mould are now to be immersed in the silver solution; in about ten minutes or a quarter of an hour the mould will be covered with a deposit of sufficient thickness to render it quite durable; the mould may now be removed from the solution, washed, and dried. It will, however, most likely be very dull-looking; it will, therefore, want cleaning, which may be done by any of the modes used by the household to clean the "plate." It is an operation requiring much time and care to get a really good polish on one of these electro-plate

moulds; however, it may be done by that patience and perseverance which overcomes all difficulties. Practically, where this electro-plating is carried on on a large scale, the goods, when removed from the "bath," or decomposing cell, are burnished with steel burnishers.

In order to be quite successful in plating, the following circumstances must be attended to:—1. The room should not be of a temperature much lower than 60°. 2. The silver plate and the mould should be immersed in the solution and taken from it as nearly as possible at the same time. 3. The copper mould must be kept *quite* clean. In order to obtain it in this state it must be dipped in a mixture of nitric and sulphuric acids, very much diluted with water, and then rubbed with a soft cloth.* When it is quite clean it is best to throw into it a tumbler of water, until the time comes to put it into the solution in the cell.

THE PERSIAN GULF TELEGRAPH.

(*Continued from page* 57.)

Reverting to our subject, the paying out of the Kirkham's cable proceeded smoothly at the rate of about five knots, until the fore tank was nearly empty. The anxious time for the engineers then arrived, the change from hold to hold would soon have to take place. The bight of the cable had to be carried up from the bottom of the hold, through the rings, and then through a narrow passage cut in the centre of the house on deck, and thence along the bridge, until it took up its new "lead" to the after tank. If the ship had the least bit too much way on her the bight would run itself up and along aft too fast for the men to handle it, and it would probably foul some projecting iron, or possibly jump itself into a kink. It was night; the first change of hold to be dealt with, and the worst, as it was from the fore to the after tank, so that the bight had to run nearly the whole length of the ship. Besides this, to avoid cutting some of the Kirkham's beams, and to dispense with the removal of the permanent galley, only a very narrow well through the galley had been built.

When there were only a few flakes of cable left in the fore hold an experiment was made as to the time the ship would take to lose her way when the motive power was taken off her, or rather as to the length of cable that would be payed out between the stopping of the Zenobia's engines and the moment when the Kirkham lost her way.

The Zenobia was eased and stopped, and the number of turns round the hold noted that passed out before the cable ceased to pay itself out. The paying out then proceeded until it was nearly time for the real change. As the time approached the watch below were called, and took their stations in the after tank, and on the bridge. Trustworthy and old hands were stationed to knock the pins at the proper instant out of the blocks in the loops of the rings previously described, to open the hawse pipe below the quadrant, and to hand the bight up to the bridge, an operation that requires some skill and experience.

Sir C. Bright took his station on the forecastle, to superintend the signalling to the Zenobia; Mr. Webb, on the lower deck, gave notice when it was necessary to ease and stop the ship, and gave orders as to the releasing or application of the brakes, and superintended the change generally; while Mr. Alexander took charge of the brakes themselves. All being ready, the Zenobia was eased and then stopped, just when it was considered, according to the previous experiment, the cable would run itself out of the fore hold by the time the ship had stopped; the brakes were at the same time released entirely. Gradually the cable swept round the hold slower and slower, then, stopping for a moment, would start into motion again, and surge out several turns round, until when, after about twenty minutes, the cable stopped entirely, there was literally only half a turn left round the hold, so well had the time required to stop been estimated.

Not a word had been spoken during this time, and as the last movement of the cable ceased the silence was complete, and was then broken only by the order to "put the brakes hard down, knock out the pins in the loops, open the hawse, and hand the bight up, and haul down in the after hold," which was executed with great regularity and precision, the bight being carefully handed up the hatch by an experienced foreman named Jackson, and along the bridge by another named Bishop. At the same time the men in the after tank hauled down the slack cable until, when the bight was thus all drawn down into the after hold, the cable lay fair in the fairleaders from the after hold to the brake. The brakes were then eased up, and the signal made to the Zenobia to "go on" at 5.35 a.m. of the 5th. Thus the first change of hold ever executed in a ship under tow had been successfully accomplished.

The paying out then proceeded as before, with great regularity. At 7 p.m. of the 5th a long abstract of political news, just received at Bombay by the English mail, was received from the shore, through the cable, on board the Kirkham, and this was telegraphed on to the Zenobia, by means of the lamp telegraph, with great rapidity. About 7.30 p.m. the change from the after to the main hold was executed, and owing to the size of the main hold and its more circular form, and the design of the rings, cones, &c., being unfettered by any consideration of beams, the arrangements here were so perfect that the cable swept round with the most perfect regularity. The speed was increased to the greatest speed the Zenobia could attain, which at times reached nearly six knots.

At 10.40 of the 6th the cable was nearly all payed out of the Kirkham, and she was anchored, when about half a mile was left in the hold, off Ras Mundarony.

The Semiramis, with the Marian Moore in tow, soon hove in sight, and the signal was made from the Marian Moore "anchor on our starboard bow," which was accordingly done.

The cable in the hold was then hauled up and coiled down on deck, and the end passed out of the stern sheave, and hauled by a hawser on board the Marian Moore; the bight of the cable was then carefully lowered over the stern of the Kirkham into a boat, and when all the slack had been hauled in on board the Marian Moore, the bight was let go from the boat at about 4 p.m., thus freeing the cable finally from the Kirkham.

During the rest of the day some of the gear, stores, and men were transhipped to the Marian Moore. The next day, the 7th, the transhipment proceeded, and the splice having been made during the night, at about 3 p.m. the Zenobia took the Marian Moore in tow, and at 4 p.m. both ships weighed, and paying out was again resumed. At 4.25 a.m. of the 8th the change from the fore to the after hold of the Marian Moore was effected, and at 9.45 a.m. the ship was anchored, and the rest of the squadron anchored off Ras Jask, where it was arranged that the ships should stop till 6 p.m., so that the opposite coast and Malcolm's Inlet might be made at daylight the following day. Towards the afternoon the weather looked threatening, but nevertheless, a start was made at 6.30 p.m., and the weather resuming its favourable aspect, the paying out proceeded as before. At 11.10 p.m. the change from the after to the main tank occurred, and was executed with equal success to the previous changes, all of which, it will be remembered, occurred during dark.

About 9 a.m. Malcolm's Inlet was entered, and at 3.40 p.m. the Marian Moore anchored in twenty-eight fathoms, having about six miles left in the hold.

Preparations were then made by Colonel Stewart for erecting a temporary camp and station on the isthmus that separates Malcolm's Inlet from Elphinstone Inlet. The place originally proposed for the station was Kasab, a village on the coast, about nine miles to the westward of the isthmus, but as no preparations for a station there had been commenced, it was determined to erect a temporary station on the isthmus itself for the present.

The isthmus itself is rocky, and steep, and high, and it required considerable labour and energy to drag all the necessary material of stores, provisions, and water for a station to the selected site. By the 13th matters were, however, sufficiently advanced to permit the landing of the end to be proceeded with, and this was accordingly accomplished by about noon, amidst salutes from the Zenobia, Coromandel, and Marian Moore. The water was deep for such an operation, and special precaution had to be taken. The usual hemp stoppers in the boats were replaced by two messengers rove through blocks in the bows of the sternmost boat, or "stopper boat." One of these was made fast to the cable, and then eased away by a turn round the tharnt, until the hitch was close aft, when the other messenger was bent on, and the first cast off, overhauled again in time to be made fast again by the time the hitch of the first reached aft. Thus all danger of a "run" was avoided.

After the cable had been properly entrenched ashore it was tested electrically, and found perfect, and the engineer's duty of laying the first section thus satisfactorily accomplished.

On the evening of the 14th the Marian Moore, with Messrs. Webb, Laws, and the rest of Sir C. Bright's staff, left in tow of the Zenobia for Bombay, in order to see the Assaye and Tweed, which ships had arrived at Bombay, finally prepared before they were brought up the Gulf.

The Marian Moore arrived at Bombay on the evening of the 21st, and the next day she was taken alongside the Tweed, and all the cable that remained in her transferred to the Tweed. All the buoys, ropes, chain anchors, and gear, together with the men, amounting to about fifty-four in all, were then transferred to the Tweed, and finally all the cabin furniture was transhipped; and on the 26th the engineering and electrical staff shifted over to the Tweed. All the preparations of the machinery and holds in the Tweed and Assaye were finally completed by the 29th, and on the 1st of March the Tweed, in tow of the Zenobia, and the Assaye, in tow of the Semiramis, started for the Gulf.

On the 11th of March the Tweed brought up off Kasab, and on the 13th the Zenobia took her in tow into Elphinstone Inlet, and anchored her near a little island where the station had been established by Colonel Stewart in place of the isthmus, when it was found the native Arabs were rather troublesome, the link between the island and the isthmus having been supplied by a piece of india-rubber covered cable, laid by Sir C. Bright. This piece of cable was found defective, and it became necessary to replace it by a piece of the ordinary Persian Gulf cable, and, as a double precaution, two lengths of these were laid on the 14th and 15th.

The Semiramis and the Assaye had arrived on the evening of the 13th, and left to coal at Basidore on the 18th. On the 18th the end from the Tweed was landed on the island, and on the evening at 5.30 of the same date the second section was commenced, the Zenobia being still the towing vessel.

The paying out proceeded well all that night. On the evening of the 19th, however, the wind, which was from the westward, freshened, and retarded the progress so that the paying out was reduced at one time to 2½ knots per hour.

At night the wind dropped, and the paying out proceeded favourably. On the 20th two changes of holds were executed with the same regularity and success as before.

On the 21st, at 8 p.m., nearly all the cable in the Tweed was expended, and the vessel was brought up, being distant from Bushire about thirty-two miles. The Coromandel had parted company with the paying-out ships off Basidore to fetch on the Assaye, in order to avoid the detention which would have taken place had that vessel waited for the Semiramis to coal. About midnight the Coromandel arrived with the Assaye in tow. The next day the end was passed from the Tweed to the Assaye, and the shifting of gear, men, and staff commenced while the splice was being proceeded with.

At 5 a.m. the Amberwitch, the little steamer that is fitted up for reparing the cable, commanded by Lieutenant Stiffe, joined the expedition.

At 2 p.m. of the 23rd paying out was again commenced from the Assaye, and at 9.15 a.m. of the same date the Assaye was anchored off the landing-place near Bushire, Lieutenant Stiffe, in the Amberwitch, having piloted the vessel to her anchorage, which was nearly three miles distant from the shore.

On the 24th half a mile of cable was coiled into the paddle-box boats of the Zenobia, and two and a half into the Amberwitch; and at 5 p.m. the bight was let go from the Assaye, and the Amberwitch payed out the cable towards the shore, and anchored about half a mile from the beach. The remainder in the paddle-box boats was then payed out, and the end landed about 8 p.m., almost in total darkness. The cable was then led up the cliff, and along a trench, to a small camp prepared for the reception of the end, about six miles to the eastward of the town of Bushire. Thus ended the laying of the Mussendum and Bushire section.

The next day Lieutenant Stiffe was despatched in the Victoria, Lieutenant Arnot, to lay down buoys on the proposed route of the cable near Fau, where the Gulf begins to get shallow, and consequently required the selection of the deepest water that could be procured for the more perfect safety of the cable.

On the 25th the Assaye was towed by the Amberwitch to a position west of her previous anchorage, so that the next section might not overlay the part just laid.

The necessary length of cable was then payed into the Amberwitch and paddle-box boats, and at 5 p.m. again the Amberwitch payed out towards the shore, and anchored close in, and the first end of the Bushire and Fau section was landed at night by lamp-light.

On the 26th, 2.50 p.m., the paying out was once more commenced, the Coromandel being a-head, the Zenobia towing the Assaye, and the Amberwitch following.

On the morning of the 27th (Easter Sunday) the Victoria was sighted in position, and the various buoys laid by Lieutenant Stiffe were passed in succession, and at about 7 p.m. the Assaye, being in about four fathoms, anchored, thus ending all the paying out that was required from the large sailing ships between Gwador and Fau.

A grand lighting up of the Assaye with blue lights on every yard-arm and mast-head, and discharges of rockets, celebrated this stage in affairs. The next morning the difficulties yet to be overcome became very apparent. No land was visible with the naked eye, and with the glass only was it possible to discern a faint broken grey line which represented the shore, where yet had to be taken the cable. This shore was about nine miles distant, the bottom shoaling gradually the whole way.

On the 28th Colonel Stewart, Sir C. Bright, Captain Bradshaw, and Colonel Goldsmid started in the Coromandel and Victoria for Fau, to reconnoitre, and make arrangements for a portion of the land line, four miles in length, which was necessary to join Fau, a village on the Shat-El-Arab, to the place where the cable was to be landed.

At noon of the same day Mr. J. C. Laws, the electrician, reported "no continuity" between the Assaye and Bushire, and the fault 92.5 N. miles distant from end on board Assaye, the insulation being at the same time perfect.

Mr. F. C. Webb, in the absence of Colonel Stewart and Sir C. Bright, then immediately began to take steps for the repair of the line, and as it was no longer of any use to keep the cable hanging over the stern, requiring, as it did, very careful and arduous evolutions, with a kedge anchor on the swinging of the ship at each change of tide (which ran here about four knots), the cable was cut and buoyed over the stern, and the ship allowed to swing freely to her anchor. The next morning (29th) at daylight the end was picked up, and the Assaye moved half a mile away from it, and the end then permanently buoyed with two buoys. The Amberwitch was then hung to the Assaye, and prepared to take cable from the latter vessel.

In the meantime Colonel Stewart and Sir C. Bright having returned and approved of all that had been done, the Zenobia was despatched to take Messrs. Laws and Lambert to Bushire, to corroborate their tests from that end of the section.

At 10 p.m. of the 29th hauling in from the Assaye, by means of the steam "picking-up" machinery in the Amberwitch, was commenced, and continued through the night without intermission, and at 11 a.m. of the 30th 21·5 miles of cable had been transhipped, which was considered ample for any repairs that might be required.

A great deal of spare machinery had then to be shifted from the Amberwitch, and afterwards the men, stores, and gear had to be shifted to the Amberwitch. This was all accomplished by midnight, in spite of a very dark night and very heavy tideway, and at 1 a.m. of the 31st Mr. F. C. Webb, at whose disposal the Amberwitch had been placed by Colonel Stewart for the operation of repairing the line, accompanied by Mr. J. Woods, took passage in that vessel, and started for the locality of the fault.

At 4 p.m. of the 31st the Zenobia was met returning from Bushire, and Mr. Laws and his assistant, Mr. Lambert, took passage in the Amberwitch, having tested from Bushire, and found that the tests taken from both ends made the fault at 93·4 from the end in the Assaye, or a difference of only 0·9 from the single test. The Amberwitch was then run on until the Island of Karrick was approached sufficiently for the ship's position to be carefully fixed by angles to the objects on shore.

The distance and course out to the position of the fault was then run, and a buoy, having a lantern on it, moored at the spot, and dredging for the cable commenced at about 11 p.m. The cable was hooked at the second dredge, and hove up by the steam machines and cut at 4 a.m. of the 1st of April. The two ends were then tested, and the fault found to lay towards Fau, but quite close to. The end of the part leading to Bushire was then buoyed and let go, and the cable wound in towards Fau. When 2·46 N.M. were in the cable was cut, and the fault found to be in the piece thus cut off. The new cable in the hold was then attempted to be joined on, but it was found that a difficulty, once or twice before experienced on other cables, here interfered with the joining of the gutta-percha. As soon as the soft warm gutta-percha was applied to the joint the percha bubbled up, and thus prevented a perfect joint, showing that air was contained in the cable between the gutta-percha and the copper. About a third of a mile more cable was then hove in, and a second joint attempted, and no difficulty experienced. The splice was then made, and the new cable payed out towards the buoy on the Bushire end; but as it was night, and impossible to see the buoy, the cable was payed out until it was known that the two ends must overlap at least a quarter of a mile when the cable was cut and buoyed. On the following morning (2nd of April) the buoy on the Fau end was picked up, and the cable wound in until abreast of the buoy on the Bushire end. This end was then weighed, and the two sections being tested and found perfect, the final joint and splice was begun, and let go at about 3 p.m. The flag buoys were then picked up, and the ship started to join the rest of the ships off Fau.

On the 3rd the Amberwitch approached the Coromandel with the signal flying, "damage is repaired," which was answered by the signal from the Coromandel, on board which ship Colonel Stewart was, "accept my best thanks."

The fault had, in the meantime, been reduced, and cut out of the portion of cable picked up, and found to be a clean fracture in the copper, which must, from its appearance, have existed for a considerable time. The ends must, however, always have remained in metallic contact, as their separation would, of course, have been detected (as it was) the moment it occurred. It would appear that even the strain required to lay the cable was not sufficient to separate them, since they were in perfect contact for twenty-four hours after they were submerged. As the cable cooled down to the lower temperature of the water at the bottom of the sea, the copper wire contracting caused the two ends to separate, thus causing the loss of continuity, without any loss of insulation, to take place twenty-four hours after the cable was laid—a very unusual circumstance.

With regard to the reason of the fracture, it must be observed—firstly, that this, in all solid conductors, is an old evil, caused by the wire becoming burnt, and thus rendered brittle by the flame impinging on it during the process of annealing. The compound segmental wire used for the first time on the Persian Gulf cable was at first open to this same danger, since it was annealed after all the segments were placed together, and the portions first manufactured were thus open to a certain extent, though in a less degree than a perfectly solid conductor, to this old danger.

As the work of manufacture proceeded several improvements in the mode of annealing were introduced, and it is believed that the latter portions manufactured are entirely free from this possible source of danger. It was in some of the very first portions of the cable manufactured that the fault in question occurred. As it was, the fault was rather a happy incident than otherwise, since it demonstrated the rapidity with which the cable could under proper management be repaired, proving at the same time the exactitude of the electrician's tests, the care with which the course of the cable had been plotted off by the surveyors, and the completeness of the fittings and machinery of the Amberwitch.

During the time that the Amberwitch was thus employed, four miles of cable had been taken round in the Comet steamer to the Shat-El-Arab, and landed at Fau, where, under the energetic superintendence of Lieutenant-Colonel Goldsmid and Commander Bradshaw, R.N., it was stretched across and entrenched in the low, flat, muddy ground from Fau to the place where it was intended the cable should be landed.

On the 4th the Amberwitch, taking all the boats that could be spared from the different ships, steamed towards the landing-place, but even she could only approach to within about three and a quarter miles of high-water mark; and owing to the absence of any objects ashore to take angles or bearings to, it was believed that this distance was nearly four and a half miles. At 7 p.m. she anchored, and all that night was devoted to coiling five miles of cable into two paddle-box boats and two barges. The next morning, the 5th, the landing of the end (perhaps one of the most curious cable landings ever effected) was commenced. A string of seven boats, looking like a kind of sea-serpent, started at slack water to pay out cable from the Amberwitch to the barely visible shore.

First came a gig towing a lifeboat, which, in its turn, towed a heavy cutter, to which hung a paddle-box boat full of cable; then another paddle-

box boat; then a barge full of cable; and, finally, another barge full of cable. Every boat, even those containing cable (except the last from which the cable was payed out) was manned with men pulling. As one boat was emptied of her cargo of cable she was removed and returned to the ship, and the next one began; and so slowly, but surely, the little fleet of boats, lessening in its number, gradually approached the shore, until at last, when two barges had been emptied and nearly the whole of a paddle-box boat, the whole grounded on the mud. The shore (if a waste of damp mud can be called shore) was still distant about three-quarters of a mile, and, from its extreme flatness, looked much further off still. After a hasty lunch in the boats, finding no help come from the shore, it was determined to attempt to drag the bight across the mud by the force in the boats; boots, trousers, coats, &c., were dispensed with, pocket-books and purses were left hastily in charge of the boat-keepers, and watches and pipes stuffed down between the neck and the neckcloth, and all then with a "hurrah" made a dash into the mud, each sinking nearly to the waist, and throwing themselves on their hands and knees to avoid sinking altogether, each separate plunge being followed by roars of laughter at the ludicrous appearance of his comrade in muddiness. On went the whole party, wallowing, crawling, sinking, and gasping like turtles, and every now and then turning round and sitting fairly in the mud to rest for a moment, or laugh at the violent contortions of some struggling individual in the rear. At last the somewhat solid ground was, to the great relief of all, reached. A storm was now brewing, the sky became suddenly overcast, and it came on to blow and thunder and lighten, and the change of temperature was so great that literally many were glad to sit down in the water with which the cable trench was filled in order to keep themselves warm. Dark, the flowing tide, and a flood of rain compelled the men to relinquish the bight, and make for the shore as fast as possible. Four miles of walk across hard and soft mud, briers, and stubble in a storm of thunder and lightning and rain completed the day's work, and brought the whole to the Coromandel and the Comet lying in the Shat-El-Arab, when a hearty dinner and roars of laughter over the day's work finished the day.

The next morning (the 6th) many were knocked-up and ill by the previous day's work in the sun, mud, and rain, &c. Sir C. Bright, Mr. Laws, and Mr. Webb, with about four or five men, alone gained the Amberwitch, and at 2.30 commenced paying out from her towards the end of the Bushire sections, buoyed near the Assaye in the Core Abdulahs; and passing the buoys on this end the cable in the Amberwitch was cut and buoyed. At slack water this end was picked up at the bows, and afterwards the buoy on the "sea end" (or end of the portion leading to Bushire); the two ends being on board, and both portions having been tested and found perfect, the final splice was made, and the bight let go at 2 a.m. of the 7th of April, thus completing the line of cable between Gwador and the head of the Gulf.

(*To be continued.*)

HALF-YEARLY MEETING OF THE TELEGRAPH TO INDIA COMPANY.

AN extraordinary general meeting of the shareholders of the Telegraph to India Company, for the purpose of declaring a dividend for the half-year ending 30th June last, was held at the offices of the company, Moorgate-street, City, on Friday afternoon, the 12th inst.

There was an average attendance of shareholders, and the following directors were present:—Sir Macdonald Stephenson (the chairman), who presided; Captain Peel; C. L. Gaussen, Esq.; and William Dent, Esq.

The business of the meeting was commenced by the chairman calling upon the secretary to read the advertisement by which the meeting was convened. That having been done by Mr. W. Mayo, secretary,

The CHAIRMAN said, there was no report to present to the proprietors, but they were convened in accordance with the Act, for their approval and sanction of the declaration of a dividend of 2½ per cent. for the half-year ending 30th June, free of income-tax. Their Egyptian line was in excellent working order, and it had yielded a considerable profit to the lessees. And in case the India and China messages should be withdrawn, there would be profit from the local sufficient to pay a dividend. They still had the Red Sea and El Arish concession; and if the Persian Gulf line was successful, they would have the Red Sea and El Arish line as an alternative line. But should the Persian Gulf line prove a failure, they would still have the Red Sea and El Arish line to make use of. He proposed that a dividend at the rate of 5 per cent. per annum be declared for the half-year ending 30th June, to be payable on and after the 15th August.

Mr. DENT seconded the motion, which was unanimously agreed to.

The meeting then broke up.

THE ATLANTIC TELEGRAPH.—By a telegram received through Mr. Reuter's agency from Newfoundland, we learn that Her Majesty's surveying steamer Margaretta, Captain J. Orlebar, R N., returned to Newfoundland on the 6th instant, with Mr. Cyrus W. Field. They have selected Heart's Content, Trinity Bay, as the place for the landing of the Atlantic cable. The harbour of Heart's Content is one of the very best in Newfoundland, and the Great Eastern can enter it with perfect safety at all states of the tide, and anchor within a quarter of a mile where the cable is to be landed.

CORRESPONDENCE.

HAWORTH'S SYSTEM OF TELEGRAPHY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—On looking through your paper this week I observed three letters on Mr Haworth's patent for telegraphing without wires. I was at first in hopes that they contained some explanation of that system, but I was disappointed. The first and second are evidently from telegraphists, and show clearly enough their opinion on the subject. The third is concerned simply with my personal self. It is a longish homily, treating on modesty and kindred virtues, and my special want of them. I am very much obliged to "E. F. G." for his lessons in humility, and will strive to profit by them. I will take him as a pattern of humility, as he evidently wishes me to do; for I perceive he is "a numble individual." But I must plead some little matters of extenuation. If I have dealt in ridicule and sarcasm, as my Mentor says, upon the word of a penitent, I really did not mean it. One thing suggests another, you see. "The sympathetic snail telegraph" would come uppermost in my mind. I could not help it; therefore, my dear Mentor, be pleased to lay that to the charge of "Association of Ideas." However beneficial this homily may be to my morals, I am afraid that such personal matters will not much benefit the art of telegraphy, nor be of much interest to the general reader. I would suggest to my Mentor, if it be not presumptuous in me to do so, that if, instead of that fine-ish writing about "elements made our bond-slaves," "the womb of the future being big, &c. &c.," "chrysalis doctors and professors," and all that sort of thing, he had just taken in hand Mr. Haworth's specification, and shown me wherein I have made an error in that which I have professed to understand, and set down in my notice of it, namely, the diagram of the currents, and the application of the laws of conduction and induction, as established these thirty years, to the attempt at understanding any useful application of such currents, this would have been a benefit to me and to the general reader. Certainly this would be rather a dull matter-of-fact way of treating the thing, and, as I can see, my dear Mentor, quite beneath your genius; but I merely say that it would have been rather satisfactory to me than otherwise; yet, at the same time, I am duly alive to the merits of that exalted, sensational-style of composition, though I do not hope ever to be able to imitate it. My dear sir, what is this? You are a friend of Mr. Haworth's, you say. Let me transcribe this. "I confess Mr. Haworth's method is a riddle to me. I cannot understand it, and to attempt to get an insight into the *modus operandi* by means of the specification of his patent is like, to use a homely phrase, 'looking for a needle in a bundle of hay.'" Is not this an accusation of deception, nay, of untruthfulness? My dear sir, I am shocked! Has not Mr. Haworth, in his specification, given his word that he has fully described his invention, and how it is to be carried out. Moreover, the law demands this as a condition to his having a patent granted, and that it be in such wise that an ordinary person can understand it. I see, my dear Mentor, that either you estimate your intelligence quite below the average, or as low even as you estimate mine, or else you make a horrid accusation against your friend. Though I do not pretend myself to understand how the end is to be obtained by the means proposed, yet *I* have not had the inestimable benefit of the author's explanation. You are convinced that he has sent messages from Brighton to London; and he has spent a fortune in doing this thing. Well, now, surely he could send a message from London to Norwood; but why did he not earn that £1,000 from Mr. Cyrus Field, which is spoken of in "A Thor Son's" letter? I suppose he scorned to take money out of a man's pocket in that sort of way, though he *could* have done it as easily as winking,—eh?

You think, then, it would have been better had I left this thing alone. I don't; for, d'ye see, in that case literature would not have been enriched by this moral essay of yours. Instead, you think, it would have been better if I had continued to bewilder people with my "by no means new" theory of force and form. Well, I think I told you at first that it was not my theory, also how old it was, and who the author of it was; of course I did, and then, like a wise man that you are, you tell me back again that it is not new. That is a marvellous discovery on your part, is it not? And very kind of you to return me my own. I cannot tell you how much I am already benefited by your lessons on modesty. But I do wish you could have given us some ideas on telegraphy in general, and on Mr. Haworth's system in particular, it would have been more to the purpose. I have no doubt a man of your kindly disposition would have done so if you had any to give. Well, you have given us what you could; so we must "rest and be thankful." In conclusion, I can only hope that "we may a' think weel o' oursels."

BLANC O'MOUGREVE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In looking over some old specifications the other day I found that a Mr. Stanislaus Hoga took out a patent in September, 1857, for "Improvements in apparatus for generating electricity, and for transmitting electric currents from place to place," and his plan appears to me identical with that of Mr. Haworth, but far more simple and plausible. The "apparatus for generating electricity" consists of a hydro-electric machine, in the boiler of which a mixture of mercury and sulphuret of mercury is used instead of water. The apparatus, by which two stations can be brought into electric communication, consists of two small boilers. Near each boiler is

placed an insulated shallow vase filled with water; at one station "the positive electricity of the jets of mercurial vapour" is conveyed to the water in the vase, "to be there dissipated in the air," thus leaving for use "the negative electricity of the boiler;" at the other station, a metallic connection conveys the negative electricity from the boiler to the vase of water, leaving for use the positive electricity of the jets. At each station two large zinc plates are "placed vertically in the ground," at a certain depth and distance apart. The plates of each pair are parallel to each other, and to the corresponding pair of plates at the other station. The upper end of each pair of plates are connected by wire, which passes through a delicate galvanometer, so that the passage of electricity from one plate to the other is indicated by the motion of the magnetic needle. "When the opposite kinds of electricity respectively at each station are in connection with the earth they run together, and pass by the metallic wire of the two plates and the galvanometer;" if, however, the electricity from only one station is in connection with the earth the galvanometer at that station is not affected, but the electricity is "dissipated in the neutral mass of the earth." If the electricity is so abundantly produced at the receiving station that its needle is affected by "the electricity which passes from the first plate to the ground without the co-operation of the electricity of the distant plate," a third plate in the ground is connected with the second plate "by a wire passing through a galvanometer;" there is no connection "between the two first plates." "When the electricity at the distant place passes to the ground, a horizontal current is formed in a line passing the second and third plate," thus affecting "the needle of the galvanometer."—Yours, &c., L. P. R.

INDIA-RUBBER COVERED CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The very sensible and straightforward communication of Mr. W. T. Henley, which appeared in your journal of the 6th ult., has left an impression upon all minds that the days of india-rubber are over, and that the futile attempt of your correspondent "Beppo," in your last number, to controvert Mr. Henley's facts was a befitting "wail" on the departure of that noisy candidate for public favour from the field, leaving its too long abused, but successful antagonist in the ascendancy. "Beppo" specially pleads for the "manufacturers" of the defunct india-rubber cable in the Persian Gulf; but why did he not bring forward a single instance in which india-rubber had succeeded? Mr. Henley, a gentleman of great practical experience, states:—"If we bury it (the rubber) in the sea or in the earth it becomes converted into treacle; if you stretch it in the air it shrivels up and peels off the wire." Is such the fact, or is it not? Let "Beppo" prove the contrary.

Yours, &c.,

17th August. R. WATSON.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I see your correspondent "Beppo" has had a fling at me this week. Why is he ashamed to give his real name? Surely people need not hide themselves behind an anonymous signature. I am happy to inform him my corns have not been trodden upon, as, fortunately, I have none. Neither was I "afflicted with a spasm of asperity" when I wrote my former letter. Neither was it written under inspiration, as your correspondent suggests, but "after quiet, calm consideration," and my only object was to vindicate myself from misstatements, as I did not see the necessity of my being made a scapegoat for other people's shortcomings. They, no doubt, concluded I was too thick-skinned to take any notice. Your correspondent does not state facts when he says the cable had to be finished at such a short notice, and I believe neither myself or men were likely to get into an "awful stew" in making twenty miles of cable, when we can, with the greatest ease, get through nearly twenty miles per day when it is required. "Beppo's" remarks about the burnt tar, and the great bunch knots, are simply absurd; and as regards the seething tar he speaks of as having seen, I again repeat such a statement is in direct contradiction to facts; and as for the tar-pot, I have none. The barrels of tar are emptied into a wooden tank, through which passes a steam-pipe, and it is never heated to such a degree that the man cannot put his hand in it. The tar used is always the best Stockholm, and but a very little heat is required to make it sufficiently fluid to saturate the yarn; and when it goes on the core it is always quite cold. "Beppo" wishes to know the number of miles of gutta-percha cables now at work, and speaks of them as having almost universally failed, and strangely enough alleges this to be the reason why india-rubber cables are so little used. He can easily satisfy himself as to the percentage of cables actually at work, and he will find a very respectable proportion in that condition; and one fact he will find defying contradiction, and that is, in no single instance has a submarine cable ever failed through decay in the gutta-percha. Other causes have contributed to the numerous mishaps in submarine telegraphy; one of the principal has been a false economy, which has led to a stinting of material in the manufacture both of the insulator and its protecting covering, by which the affair has been starved in its birth, and its life thereby reduced to the shortest limit; others have been injured in the manufacture from a want of proper care, whilst some have been ruined in the submergence; but practice makes perfect, and all those sources of failure will be guarded against in future operations; and whilst we can depend on the insulator—which we certainly can in the case of gutta-percha —the remainder is easy. "Good wine needs no bush," and gutta-percha requires no puffing; its advocates are quite content to let it rest on its own merits, leaving the friends of india-rubber to sing praises of that material to their heart's content; but I think they are rather short of certificates of its good behaviour, when one in Messrs. Hall & Well's advertisement (which I suppose has been selected as the best) gives it a rather qualified character when it merely says *it looks perfect*. I apprehend many things are perfect in appearance, which are very far from being so in reality. As I leave for the Adriatic the first thing on Monday, I shall not have the pleasure of seeing what "Beppo" and other friends of the sticky gum may have to say in your next number, until some time after its issue. In the meantime, I can only wish success to the science, and hope "Beppo," and others will see the error of their ways, and apply their abilities to something more promising and profitable than bolstering up the cause of a deceitful material that hides its faults until all the expense and trouble has been incurred of making it into cable, and placing it in an important position, when failure can only bring discredit to all concerned.

August 13th, 1864. W. T. HENLEY.

THE SUBMERSION OF DEEP-SEA TELEGRAPH CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—There has been during the last few years numerous ingenious contrivances suggested and patented for laying down telegraph cables in deep seas, and perhaps the one which received the most attention is that advocated by Captain Selwyn, R.N.—namely, the employment of a floating cylinder. I have always understood that the idea originated with the gallant captain, but I find that a patent was taken out for a similar plan by a Mr. Lavater, in December, 1857. The inventor states that "the cable was to be wound ashore upon a floating drum or cylinder, to be unrolled out at sea by means of the axles of the drum being fastened by chains to a steam-tug. I should be very glad if you, or any of your readers, would give a full description of Captain Selwyn's proposed arrangement in an early number of the *Telegraphic Journal*.—Your obedient servant,

16th August, 1864. E. MARTIN.

SUBTERRANEAN TELEGRAPH LINES IN FRANCE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I notice in your publication of last week, in the article by myself upon the subterranean lines of France, that by some inadvertence the inventor's name is not mentioned. After the second paragraph it should have read thus:—"These underground wires are protected during their whole length by an hermetically-sealed iron tube, the invention of Mr. Baron, inspecteur des lignes télégraphiques, Français, to whom the credit belongs for producing the most reliable system of subterranean lines."

Yours truly,

Paris, 16th August, 1864. D. E. HUGHES.

THE ELECTRIC LIGHT.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Would you be good enough to inform me, in your notes to correspondents in your next issue, what battery you consider the best, *taking the cost into account*, for showing the electric light. The Maynooth, so far as I am able to judge, is the best, but the noxious fume of the nitric acid is objectionable; and perhaps Daniell's, though costing more at first, is better; but I shall be glad of your opinion. Also, as to the number of cells required to show the voltaic arc for experimental purposes. I suppose the apparatus for keeping the carbons the right distance apart will be an expensive one—that is, that which is self-acting.—I am, Sir, yours truly,

Southport, August, 1864. A CONSTANT READER.

[Our correspondent will find some useful information concerning a new battery recently introduced for lighting purpose, on reference to our column of telegraphic news.—ED. *T. J.*]

TELEGRAPHIC NEWS.

THE TELEGRAPH IN CHINA.—Many of our readers are, doubtless, acquainted with the fact that it is in contemplation to lay down a line of telegraph between Shanghai and Woo-sung. The local native authorities have accorded their permission, and the enterprise will, we understand, when complete, be in some way connected with a Chinese office. The advantages which must accrue from the construction of a telegraph line are manifold. Vessels will be instantly reported to Shanghai as soon as they come in sight at Woo-sung. Vessels which may accidentally run ashore will not be left longer in a perilous position than may be necessary to transmit a message to Shanghai, and send a tug to the rescue. It will, moreover, prove a step towards establishing a line up the Yangtsze, to the north, and eventually to Hong Kong. The sharp end of the wedge having once been inserted, the rest will naturally and easily follow. It is also worthy of notice that railways and telegraphic lines generally follow one another. We may, therefore, expect to see a railroad opened within a few years, and then the subjugation of China by European civilization will be an accomplished fact.—*London and China Telegraph.*

Application of Electricity in Warfare.—The terrific explosion of the mine under one of the defences of Petersburg, and which proved so disastrous to human life, was effected by electro-magnetism, the apparatus employed being similar to that employed by the royal engineers at Chatham, the invention of Professors Wheatstone and Abel.

Telegraph Clerks' Provident Fund.—The above institution gave a conversazione, on the 8th ult., at Barnsbury-hall, Islington, which was exceedingly well attended. The chair, in the early part of the evening, was occupied by George Sheward, Esq., one of the directors of the London District Telegraph Company, and of the London and North Western Railway Company, a gentleman who has at all times evinced the greatest solicitude for the welfare of telegraph employés, and who, on this occasion, fully explained the object of the Fund, and gave a very cheerful account of the progress already made. On the conclusion of the chairman's address the programme of the evening was proceeded with, which consisted of the following selections:—Pianoforte duet, Misses Eden and Drew; song, "Sweet Spirit hear my Prayer," Miss A. Stanhope (accompanied by Miss Drew); dramatic selection from "Lady of Lyons," Mr. James Cook; duet, Misses Bristow; an address, Mr. John Young; song, "My Nannie 's awa'," Mr. Thos. Hood; "The Song of Slavery," Mr. Jas. Cook; Song, "Annie Lisle," Mr. Bowyer; "A Parental Ode to my Infant Son," Mr. Jno. Young; illustration of the late Mr. T. Hood's poem of "Skying a Copper," in the character of *Sarah Ann Grubbles*, a housemaid, by Mr. Jas. Cook; song, "Kathleen Mavourneen," Miss A. Stanhope (accompanied by Miss Drew); song, Miss M. Eden; the roaring farce, entitled, "Number One, Round the Corner,"—*Nobbler*, Mr. W. Coleman; *Flipper*, Mr. R. J. Garrard; *Jem*, Mr. W. Simmonds; *First Floor Lodger*, ——. National anthem.—The pianoforte duet by the Misses Eden and Drew was deservedly applauded, and Miss A. Stanhope (accompanied by Miss Drew) elicited the liveliest marks of approbation, the songs being rendered with a depth of feeling, taste, and sweetness not often to be found at amateur performances. The Misses Bristow also contributed to the pleasures and delight of the evening by a well-executed duet, which was rapturously applauded. The gentlemen also sustained their respective parts of the programme with admirable effect and ability. Mr. Hood is an excellent singer, and was enthusiastically encored and cheered. Mr. Cook recited some dramatic selections from the "Lady of Lyons," and, in the character of *Sarah Ann Grubbles*, subjected the "risible faculties" of his audience to a lively and refreshing exercise. Mr. John Young delivered an address explanatory of the objects of the institution, and we regret our inability to place the same before our readers, not having been favoured with a copy. "The roaring farce," entitled "Number One, Round the Corner," in which the members of the International Dramatic Club appeared, was exceedingly well performed, and provoked mirth in abundance; Mr. Coleman—the comical *lion*—as usual sustaining his part with marked ability, amidst *roars* of laughter. The evening was pleasantly wound up with a merry dance, to the lively music of Miss Drew, the accomplished and obliging pianist. It is seldom that we have had the pleasure of joining an assembly where so much good and friendly feeling appeared to exist, and we hope that such efforts to bring together, for mutual benefit and advantage, so numerous a class of public servants, will be persevered in, and that the worthy example shown by Mr. Sheward will be speedily followed by others of the directors of telegraph companies. We were sorry that the esteemed and indefatigable secretary of the institution was prevented from being present owing to severe illness.

Blasting an Immense Chalk Cliff by the Royal Engineers.—For several weeks past a number of Sappers and Miners from the Royal Engineer establishment at Chatham, in charge of Lieutenant Thomas Fraser, have been employed in sapping and mining for destroying a portion of an immense cliff of chalk at Halling, in the occupation of Mr. Thomas Weekes, lime and cement manufacturer, near Rochester, the cliff being the property of the Earl of Darnley. The engineer officer and men have been daily employed in driving galleries and sinking shafts, and all the necessary preparations for the blasting of the cliff were completed on Saturday night last. The chalk to be removed is estimated to amount to about 100,000 tons; and some idea may be formed of the immense blast required to dislodge such a huge mass, when it is stated that the quantity of gunpowder used in the operations weighed in the aggregate 5,400 lbs., distributed in five charges. There were four immense shafts bored in the summit of the cliff, and these were carried down to a depth varying from 64 feet to 25 feet in the chalk. In order to prevent accidents on the occasion of the explosion, the ground, for a considerable distance round the base of the cliff, was kept clear by soldiers. The battery for transmitting the voltaic current to the charges was placed about 200 yards from the shafts, the spark being conveyed by wires coated with gutta-percha from the battery known as Groves's, having forty cells. The operations for blasting the cliff took place on the 16th instant, and nearly all the principal officers of the Royal Engineers were present on the occasion. Colonel Harness, C.B., the director of the Royal Engineer establishment at Brompton; the Earl of Darnley; Colonel T. B. Collinson, instructing engineer officer; Colonel J. F. M. Browne, C.B., field officer of military discipline; Colonel Lovel, C.B., and many other officers of distinction were present. The effect of the explosion was not only grand, but wonderful; the whole crown of the extensive rock was lifted up several feet, and the ground for some distance vibrated under the feet of the numerous body of spectators, and everything went off very satisfactorily. The chalk thus blown down is some of the best for lime and cement purposes, and, of course, very valuable.

Telegraphy in France.—Efforts have been made to consolidate the post-office and telegraphic services in France; but, owing to the strong opposition evinced on the part of the chief functionaries of both services to such an amalgamation, it appears that the idea has been for the present relinquished by the imperial Government.

Telegraph across British North America.—The Hudson's Bay Company lately appointed the Arctic explorer, Dr. Rae, to visit the country between Red River and the Pacific coast, to select the proper line for the telegraph. That gentleman reached Fort Garry about a month ago, and is now far on his way across the plains of the Saskatchewan, and we are now enabled to make the further announcement that 77 tons of wire, nearly half the quantity required, have arrived at Montreal, and the balance will be here very shortly. The wire is to be forwarded at once by the Grand Trunk Railway Company to Sarnia, and by steamboat to the head of Lake Superior, whence it will be transported next winter to Fort Garry on the Red River, at which place the whole of the wire, insulators, &c., will be collected by the beginning of the spring.—*Montreal Gazette.*

India-Rubber Covered Cables for Government.—The War Department of her Majesty's government have recently been supplied with a length of telegraph cable for use, we believe, in some of the new experiments about to be instituted. This is a multiple cable having two conductors, each one consisting of a strand of seven No. 24 copper wires, insulated with india-rubber to a total diameter of three-eighths of an inch. The two cores thrown together are then served with yarn, and neatly braided over with the same material, the yarn having been previously well saturated with tar, and allowed to get perfectly dry before application, in order to prevent it injuriously affecting the rubber. The choice of india-rubber telegraph cables evinces an enlightened appreciation, on the part of the authorities of the War Department, of the advantages this material offers as an insulator, and demonstrates, moreover, their satisfaction with the cables heretofore supplied,—this making the sixth of a series which have been brought into use in various ways, and which indeed have rendered the most efficient service in the numerous important experiments already made known to the public. This cable, in common with all previous ones supplied to the War Office, was manufactured by Messrs. Wells & Hall, and is made in strict conformity with their patent. It is but just to observe that they are all in perfect preservation, and with every appearance of continuing so. With so many gratifying evidences of the excellence of this method of manufacturing cables, we may venture to indulge the hope that it will speedily be tried on a more extended scale, and be successful in solving the great problem of ocean telegraphy.—*From a Correspondent.*

The Electric Light.—At a meeting of the Inventors' Institute, Mr. J. Dickson read a paper "On Certain Inventions for Insuring the Economical and Efficient Production of Voltaic Electricity for Lighting Streets and other Purposes." The object of the paper was to explain the means by which electricity could be readily and economically produced. The history of voltaic electricity was carefully traced from the time of Volta, from whom this form of electricity took its name, to the present time, special mention being made of Grove's, Smee's, the Maynooth, and other batteries, which from time to time have been looked upon as vast improvements upon then existing apparatus. The theories of Mayer and Joule were referred to, as well as the researches of Professor Tyndall, whose "Heat as a Mode of Motion" contains so much valuable information upon the subject. He considered that the rapidity of the vibration of the atoms in a conductor was exactly in proportion to its conducting power, and explained that, whilst a battery was producing light and heat, less material was being consumed than when the battery poles are directly connected with each other. Mr. Dickson's battery was described as one of the hot-class—the sulphuric acid was heated to 600° Fahr. He claims, by his mode of applying heat, to be able to use iron and other cheap metals, instead of the dear ones—zinc, copper, &c. The relative mobility of the atoms of an electrolite determined, he considered, its force rather than its specific gravity. When oil of vitriol was heated to 350° Fahr. only, the electric action is less powerful than when heated to 600° Fahr., probably owing to the waves being less rapid. With the necessary percolating apparatus he was convinced that his battery would be successful for lighthouse purposes. He considered 15 to 20 of his cells equal to 20 to 22 cells; 3 of his cells are not equal to 2 of the nitric acid cells, but the increment in his battery was greater. Grove's battery cost 1s. 5d. to produce the same amount of electricity as that produced for 10½d. by Dickson's. Comparing the lighting powers, 11½d. with the caloric battery will produce the same amount of light as 1s. 5d. by Grove's. He declared that the sulphur liberated at the negative poles could be reconverted into sulphuric acid to the extent of $\frac{19}{20}$ths. The oil of vitriol during the working of the battery becomes combined with water, but the acid is easily and cheaply reconcentrated. In Smee's, Daniell's, and Grove's battery the sulphate of zinc cannot be recovered, whilst in his caloric battery the recovery was not difficult. The chairman expressed the fear that the invention promised so much, that he was no more likely to perform it than to obtain perpetual motion; indeed, if the invention were not overstated, they would certainly be nearer perpetual motion than they had ever been before. Mr. Varley suggested that, as the principal feature in the invention appeared to be the heating of the materials, it was not impossible that it might be as great a step in advance as the introduction of the hot-blast in the manufacture of iron; this, of course, remained to be seen. The new light was exhibited at the meeting on the 18th of February, when an opportunity was afforded for examining the caloric battery in operation.

Telegraphy in South Australia.—Mr. Todd, superintendent of telegraphs, is preparing a report respecting a telegraph line to the northern coast, to be constructed in conjunction with the other colonies.

The Telegraph in Persia.—We have just waded through certain papers published in return to an address of the House of Commons, dated February 15th of the present year, and we are fain to admit that the impression left on us by their perusal has been anything but favourable to the manner in which the present government appears to conduct our affairs abroad, and to its mode of rewarding those who have rendered it sterling service by bringing a most important matter to a successful issue, when the officials first entrusted with its management had signally failed to accomplish the desired end. The documents we allude to are those connected with the convention ratified by both the English and Persian Governments in February, 1863. The subject of the convention was the telegraphic line through Persia, and although Lord Russell appears to have commenced his negotiations with the Teheran government, through Mr. Alison, in May, 1861, that officer having reported his inability to effect anything in April, 1862, this most vital question remained in abeyance until brought to a satisfactory termination by the energy and diplomatic skill of Mr. Eastwick, on the 19th of December, 1862. After his first failure, Mr. Alison rested on his oars until fresh injunctions from his chief of the Foreign Office obliged him to address the Persian government anew, in September, 1862. After upwards of a month spent in "*des pourparlers qui n'aboutissaient à rien*," Mr. Alison left Teheran for the good of his health, and pending Mr. Eastwick's return from Meshed, the capital of Khorassan, whither he had gone on a special mission with reference to the invasion of the Herat territory by Dost Mahomed Khan, Mr. Ronald Thomson, the Oriental secretary, became *pro tem.* chargé d'affaires. Mr. Thomson was not more successful with the Persians than her Majesty's ministers, and yet Mr. Eastwick almost immediately after his return, and whilst suffering from severe ill health, induced by the climate and exposure, and by the rough travelling, bad food and lodging, for which Persia is infamous, managed with great tact to obtain the consent of his Majesty the Shah to a convention, which entitled the British government to ensure its connection with its empire in the East by means of a line of telegraph through Persian territory. It is then to Mr. Eastwick, and to him alone, that we are indebted for this benefit—one that we can never prize too highly, when we reflect how much of the well-being and happiness of our own folk at home depends upon the security of our Eastern possessions. We regret to notice that after Mr. Eastwick's sudden and unexpected departure from Teheran, and Mr. Alison's subsequent return to the seat of his mission, an attempt was made to substitute a new convention for that already agreed to by Nazir-ood-deen Shah, but at the same time we are well pleased to observe that the Persian minister objected *in toto* to any change in the arrangements made by Mr. Eastwick, who is, therefore, still the man the British public ought to thank for a genuine service effected under difficulties of which no one who has been unaccustomed to Persian wile, prejudice, and fanaticism, can form any accurate idea. As to Mr. Eastwick's reward for the above service, we are not as yet aware that it has been in any way commensurate to its merits. We, on the contrary, see that an attempt was made by Mr. Alison after his return to Persia to show the existence of inaccuracies in Mr. Eastwick's translation of the convention; what Mr. Alison's motives in doing so were we dare hardly say, but we should be glad to see all the reasons of Mr. Eastwick's removal from his post at Teheran brought prominently brought before the British parliament. —*Morning Herald.*

MISCELLANEA.

A Costly Patent Law Suit.—The great paraffin case of Young *v.* Fernie is said to have involved an expenditure of about £40,000.

How to Work.—It is better to accomplish perfectly a very small amount of work than to half-do ten times as much.

Dissolving India-rubber.—It deserves to be generally known that petroleum is an excellent solvent of India-rubber, and is 50 per cent. cheaper than benzole.

Peals of Bells.—A correspondent of the *Builder* says:—"We have now in London and different parts of the United Kingdom about 14 peals of twelve bells, 50 peals of ten bells, 600 peals of eight bells, 700 peals of six bells, about 400 peals of five bells, and a great number from one bell to a chime of four bells; and all these peals of five to peals of twelve bells cost each from £300 to upwards of £2,500. So you see what a merry ringing island England is; and a melodious peal of bells is perhaps not less captivating than the finest toned instrument ever yet invented."

The New Metal.—Magnesium was discovered by Sir Humphrey Davy in 1807, but remained little else than a chemical curiosity until 1862-63, when Mr. Edward Sonstadt patented a series of processes, whereby it may be produced in any quantity. Magnesium is a metal white as silver, and very light, its specific gravity being 1·74, or about one-fifth the weight of copper. In the form of wire it may now be purchased at 3*d.* per foot at all the principal metallurgists, opticians, and photographic material dealers. If the end of a piece of wire be held in the flame of gas or candle, it at once takes fire, and burns gently with a dazzling white light, by which a photograph may be taken with a perfection equal to sunshine. The wire supplies an excellent specimen of the metal, and the burning of a few inches is a brilliant and interesting experiment.

Silence in Nature.—It is a remarkable and very instructive fact, that many of the most important operations of nature are carried on in unbroken silence. There is no rushing sound when the broad tide of sunlight breaks on a dark world and floods it with light, as one bright wave over another falls from the fountain, millions of millions of miles away. There is no creaking of axles, or groaning of cumbrous machinery as the solid earth wheels on its way, and every planet and system performs its revolutions. The great trees bring forth their boughs and shadow the earth beneath them, the plants cover themselves with buds, and the buds burst into flowers, but the whole transaction is unheard. The change from snow and winter winds to blossoms and fruits and the sunshine of summer is seen in its slow development, but there is scarcely a sound to tell of the mighty transformation. The solemn chant of the ocean, as it raises its unchanged and its unceasing voices, the roar of the hurricane and the mighty river, and the thunder of the black-browed storm; all this is the music of nature—a great and swelling anthem of praise, breaking in on the universal calm. There is a lesson for us here. The mightiest worker in the universe is the most unobtrusive.—*Brakus.*

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100	British and Irish Magnetic, A.	all	60 to 65 x. d.	—
Stock	Electric Telegraph . . .	100	102 to 116 x. d.	—
100	Submarine Telegraph, scrip. .	all	45 to 55	—
all	Do. registered	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1½ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 3½ x. d.	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to par.	—

TO CORRESPONDENTS.

J. H. G.—Received with thanks. Any further information concerning telegraphy will be highly esteemed.

D. E. H.—We regret that a clerical error should have partly vitiated the contribution, and that it was impossible, at the date on which your letter was received, to make the proposed arrangements, the type having been distributed.

K. R.—We shall insert a list of all existing telegraph companies next week, and shall feel obliged in the meantime for information respecting change of officers or offices which may have recently taken place.

J. Sanderson.—Means are now extensively adopted in the metropolis and elsewhere for uniting police and fire-offices by electric telegraph. We believe that there are several large establishments in London who maintain a telegraphic communication with the chief or subordinate offices of the fire establishment. As you have not described the instrument you propose to employ for effecting instantaneous communication between public and private establishments, we cannot offer an opinion as to the practicability of insuring it by letters patent.

A Subscriber.—Back numbers are kept on hand, and may be had from the publishers.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

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THE TELEGRAPHIC JOURNAL.

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FORCE AND FORM.

CONTRIBUTED BY B. O'M.

VI.

HAVING now arrived at the full form of our atom, it is necessary that we bring some confirmations in support of it from experience. This we shall do from electricity and magnetism.

That matter is not formed of hard, unalterable atoms can, as I think, be proved by electric conduction, and has been so proved by Professor Faraday, somewhat in this way:—Some substances contain more matter in the same bulk than others, or which is the same thing there is a difference in the specific gravity of different substances: as, for example, platinum and silver. There is no substance that is not capable of compression, neither is there any that is not capable of expansion. This being so, then on the theory of hard, unalterable atoms there is no substance in which the atoms that compose it are in contact; therefore, in all cases, matter is composed of solid atoms and void spaces. This must be so; for on this supposition all material atoms are unyielding, therefore not elastic or contractile and expansible.

Now if matter be composed of hard particles or atoms, and void spaces, it must be by means either of the hard particles or of the spaces that matter conducts electricity. Taking silver and platinum. Now silver is a ten times better conductor than platinum; but platinum contains more matter, bulk for bulk, than silver; therefore it would appear that it is the void spaces in silver which constitutes it a better conductor than platinum. Now take silver and gumlac. There is more matter in silver than in gumlac, bulk for bulk, but silver is a million times a better conductor than gumlac; therefore it would appear that it is the solid atoms in silver that makes it be a better conductor than gumlac; so that in silver the hard particles are better conductors than the spaces, and also the spaces are better conductors than the hard particles: which is absurd. But there is one hole for escape, namely, that all atoms are not of the same density; that the atoms of each simple substance have their own specific density. Now as silver is the best conductor of electricity, it must be either because it contains a greater number of atoms, bulk for bulk, or greater spaces; for density is put out of the question, that is accounted for in the atoms themselves. If the great number of atoms in a given space gives it its conducting power, then it must be the least compressible of all substances; or if there be any substance less compressible, that substance must be a better conductor. Glass is a less compressible substance than silver, but glass is a worse conductor of electricity; therefore it must be the great inter-atomic space of silver that gives it its conducting power. Then silver will be the most compressible of all substances, or if there be one that is more compressible, that will be a better conductor. India-rubber is a more compressible substance than silver, but india-rubber is a worse conductor; therefore, again, the atoms conduct better than the spaces, and the spaces better than the atoms: which is absurd. The only escape is, that matter is not so constituted. Again, it is not possible for the atoms to conduct, for in no case is there continuity; it is in the spaces only that there is continuity; therefore, of the two, the spaces are more likely to be the conducting medium; but then, in that case, a vacuum ought to be the best conductor, but it is the worst. Therefore on none of these suppositions can the facts of conduction be explained, and if there be any other supposition possible, which will make hard atoms and conduction agree, then I should like to see it. Just one more argument against hard atoms. Since on no substance do the atoms that compose it touch each other, by what means are they held in proximity, or how were they brought into that proximity? It is said, by *attraction*. Then what prevents them from being brought into contact? It is said, repulsion. That is, attraction up to a certain point, and then repulsion after that! But is not this "pulling without hold, and pushing without touching?" Or rather, is it not an absurdity?

Unyielding, unalterable atoms then, are not in agreement with facts and reason. Let us see how ours will cover the facts, and thereby satisfy reason. But first, our confirmations. The magnetic sphere of potency is an apt illustration of our atom, though the magnetic sphere is in the elemental series; still the law is the same generally, though differing by discrete degrees of forms.

Take a symmetrical bar magnet, and place over it a card; upon this card sift iron filings, and gently tap the card till the iron filings arrange themselves according to the magnetic lines of force, as in Fig. 1.

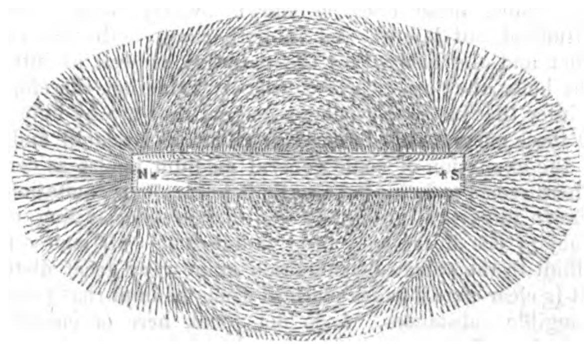

FIG. 1.

At first sight the fluxion of this force will not appear to resemble the fluxion of our atom; but when analysed we shall see that it is so. In the first place, in all permanent artificial magnets, that I have examined, the poles are not at the ends, but a little way from them. In this instance they are at S and N; therefore the true magnetic sphere extends no further than these; consequently the true magnetic sphere may be considered as extending no further than the complete curves terminating in N and S. This will leave a sphere similar to that in Fig. 2.

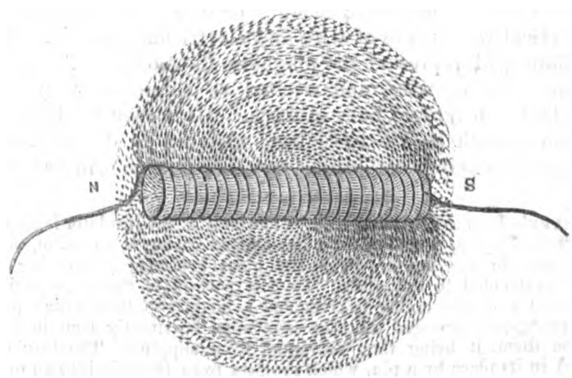

FIG. 2.

This is a simple coil of insulated wire, on a piece of wood.

If arranged as the preceding magnet, represented in Fig. 1, and then a current of electricity passed through it, the sphere of magnetic lines of force will be represented as in Fig. 2. Reverting now to Fig. 1, it will be seen that the lines of force pass from N to S, as meridians, whereas in our atom they spirate laterally. We have no means of showing this sphere of force adequately, but by means of iron filings; of course very small magnetic needles would show the same, but that is really what these filings become. Now it is a well-known fact that a small bar magnet, or particle of iron, if at liberty to move, will arrange itself across a current of electricity, and at right angles to it. Now look at Fig. 2, and you will see that this is just what these small particles of iron have done. Then by inference can you not see that there must be just such currents round the artificial magnet, represented in Fig. 1. There is no difference between sphere Fig. 1, and sphere Fig. 2, except this, that sphere Fig. 2 is more perfect than sphere Fig. 1, not having these excrescences at the ends. Why we cannot yet make a perfect artificial steel magnet, I cannot tell at present. Surely one can be made. At least I mean to try.

It has been abundantly proved by Faraday that each magnet contains within it an amount of lines of force equal to the amount it has surrounding it, by means of the electricity excited in the moving loop, and as he has proved it for the permanent magnet; it is also proved for the helex of copper wire, which is a perfect magnet, when electrically excited; therefore within the helex, Fig. 2, there is the same amount of magnetic lines of force as there is surrounding it. Now, as before stated, these lines, as shown by the filings, are not longitudinal, but lateral, and in both cases, both that of the magnet and the helex, they are external as well as internal. In the helex they are clearly caused by induction, therefore we may infer that in the permanent magnet they are by induction. That these currents are induced there can be no doubt, and that it is the excitation of some general medium is also as certain, for there seems to be no precise limit to it; such excitation can be shown to exist at greater or less distances, according to the delicacy of the instrument used to detect it. Of course there is a limit to the sphere of induction at no very great distance, but it is clear that it takes place in some medium that pervades all tangible substances. I do not speak here of electric induction, but of magnetic; for though these two are intimately connected, it is evident that they are separated by a discrete degree of difference: but this by-and-by.

Here then it is plain that you have in a magnet a similar fluxion of force to that which we have seen to ultimate the form of our atom. There are the polar spirals, and there is also the circumferential spiral. To show this more clearly, just take the atomic vortical and enclose the polar spirals in a parallelogram, to represent a bar magnet; then draw meridians from pole to pole, which meridians will pass at right angles across the lateral circumferential spirals, which is the position which a series of small magnetic needles or iron filings would take if the vortical were made of wire and electrically excited. These meridians will represent the magnetic lines of force, and if the vortical were of wire, and excited as supposed, they would really be the magnetic lines of force. Here then we have force in a form, such as we have been striving to describe, which there is no denying, and which no other fluxion will explain.

THUYER'S IMPROVED INSULATOR.—The body of the insulator is composed of a block of glass, protected by a bell-shaped casing of cast iron, through an opening in the top of which the glass projects; the casing being strongly cemented to the glass. To that portion of the glass projecting from the top of the casing is cemented a metal cap, from which projects three prongs, so arranged that the wire must be slightly bent in passing between them, it being thus prevented from slipping. The insulator is secured in its place by a pin, which projects from the pole into an opening in the underside of the glass. Both the cap and casing are thus so completely insulated that there can be no communication between the wire and the pole.

THE MALTA AND ALEXANDRIA CABLE.

By AMICUS.

By order of the House of Commons, dated 9th July, 1863, was printed "A return of the total expense of laying a telegraph cable between Malta and Alexandria, specifying separately the cost of the cable, the expense of laying, and all other items of expense, &c." This paper together with a copy of lease made with Messrs. Glass, Elliott, & Co., was reprinted in a contemporary journal now defunct. The total net cost of this cable was £436,283 10s. 8d., and is leased to the above firm till the 1st of January, 1867. This being the only submarine cable of any consequence really in existence, any information concerning it is always doubly welcome to those who take an interest in ocean telegraphy. The statement of the number of messages forwarded and the aggregate receipts for the years 1862 and 1863, published in No. 30 of the *Telegraphic Journal*, is gratifying as indicating an increased use of the line, which we may further assume is indicative of an appreciation of the advantages it offers. Supposing the cable should last until the lease expires, and the same rate per cent. of increase in receipts should be attained year by year, the amount for the last year of the lease, ending the 1st of January, 1867, would reach the large sum of about £120,000. Of course nothing presents so dazzling a prospect as submarine telegraph enterprise when the calculations are based upon suppositions, not forgetting also to assume that there be no disaster. Doubtless these prospects would in some degree be realised if we could only ensure immunity against failure, and be absolutely certain of being able to obtain good and durable cables. But here is the rub: there is really no trustworthy data on which to build even a conjecture. With the exception of this line there is no long cable in existence, neither home nor foreign; it is to be hoped, however, that another twelve months will change the state of things, and that there will be at least two additional cables that will afford us some idea as to whether they will pay in every sense of the word; but that can hardly be decided until a term of years shall have elapsed. Something very different must be realised from what is presented by the cable in question in order to constitute it, in the strict sense of the word, a paying concern. We know the cost of this cable, and we know also the money value of the work done through it, and here our knowledge stops short.

Taking the most favourable period—the year 1863—it will be seen that the receipts are some 12 per cent. of the capital invested, and providing there were no other side to the ledger this would be pretty respectable, and yet nothing to boast of, seeing that this cable certainly cannot be a long-lived one. At that rate of income the cable must remain in good working order from ten to twelve years ere sufficient would have been received to refund the original outlay and interest thereupon; so that with the same amount of receipts, and reckoning 1863 as an average year for expenses also, we must double that period before the original outlay would be repaid, as doubtless the cost of working the line, and the heavy outlay for repairs which had to be met last year, would swallow far more than half the receipts. It will be remembered that a break occurred in July of last year, and some may be disposed to object to 1863 being considered an average year for disbursements; but it would hardly be safe to reckon on less than one interruption each year: it has averaged that, and may be more. The working expenses of the line must be heavy, and as according to the lease a vessel should always be kept cruising about in readiness to make repairs in case of the cable parting or what not, and that that vessel must be manned, and all the rest of the expenses incurred by a ship that may be ordered, heaven knows where, at an hour's notice, it follows that an extra heavy and constant drain is going on upon the resources of the lessees, and tending very seriously to increase the debtor side of the account. And when a break really does occur, besides the regular crew of this vessel, a bevy of electricians and experienced men in repairing and splicing a cable have to be added.

The lessees have promised a statement of the cost of repairs, or, if not promised, they state why it has not yet been given. It would be very desirable to be in possession of this information; in the meantime, however, we are thrown back upon conjecture, and are left to wonder if the cost of constantly keeping a ship in readiness, and its employment when there is really work for the crew to do in underrunning the cable, &c., bears any proportion to the item termed "ships" in the Parliamentary paper referred to above. "Ships" are set down there at the handsome sum of £110,500. Of course this means for the hire of the ships, not the purchasing of them, as some innocent people thought. It has been stated

somewhere that the reason why this item took six figures to express it was, that it included the time they lay in the docks while the cable, which was originally intended to connect Rangoon with Singapore, was being coiled up, &c.; but having put out to sea, had not proceeded far before the precious freight was discovered in a state of fusion: the percha a mass of pulp, and the copper almost protruding in places like the backbone of a cabby's hack, hence the vessels had to put back to port. It is further stated that these ships, with their cargo (but not the crew), were sunk in order to prevent the 1,400 miles of cable, made at an expense of some £300,000 for core, sheathing, &c., from degenerating into such a condition from increased temperature as to risk its entirely running away, leaving bare bones only, which would of course be useless. By this means it is to be presumed liquidity was prevented, and the cable retained sufficient shape and consistency to be ultimately submerged between Malta and Alexandria. Doubtless this would help to swell the cost; but making every allowance for this, it is an enormous sum of money, and takes us back to cogitate that if "ships" *now* engaged upon the cable, in work and out of work, bear any proportion to "ships" *then*, it forms an important item on the wrong side of the book. But in addition to this amount for "ships," there was paid to the contractors for submersion a further sum of £25,000, so that to get this cable safely to the bottom of the sea cost £135,500, or about £97 per mile! Well, if it was worth this princely sum to get it there, what is it worth to keep it there? If it were worth £25,000 to the contractors for submerging alone, what must the lessees debit underrunning, splicing, and general repairs at? If present operations bear any proportion to the original outlay, it is certainly under-estimating the cost of keeping the cable in working order and general expenses, as absorbing far more than half the receipts for one year; and hence at that rate the cable will not have paid for itself in a quarter of a century—a period of existence which it is simply absurd to expect it to attain. Singularly enough, although the most unfortunate cable ever made, it is yet the only one that can lay the smallest claim to success; strictly speaking, however, it is only successful in so far as it has been laid and signalled through; commercially, it is not so (although it may be to the lessees). "Successful cable" is a misnomer if there be but 5 per cent. realised upon so vast an outlay, exposed to so many risks, and on a work of so perishable a nature; for cessation of signalling, if not attributable to some accident, means decay, or some process analogous thereto, going on in the gutta-percha, and that this is the case we have the testimony of the first electricians in confirmation of. Ever and anon, therefore, the cable must be hauled up for repairs—a dangerous, although indispensable process, by which a cable is only temporarily benefited, but permanently injured; it follows, therefore, that the oftener a cable has to be treated in this way, the speedier will be its total collapse and uselessness.

It certainly would appear from this view of the case that this line can only be added to the list of failures, it being simply one of degree. It certainly demonstrates the practicability of long submarine cables; but unless a better style of cable can be made, and an insulation adopted that will be proof against decomposition, chemical or otherwise, all essays in this line must, commercially speaking, prove failures. Yes, there is one other way of avoiding it, by reducing the original outlay; but in that case ships must not cost £110,500, nor submersion £25,000, nor superintendence £20,000, nor instruments (for three or four stations) £5,000, and so on.

As Parliament and the country must take cognizance of the cost of repairing this cable, the amount will of course be made known—that is, if any member be wide awake enough to direct attention to it; but it may never come to light what the general expense of working the line is unless the lessees choose to publish it, and yet at this crisis of ocean telegraphy such data as this would afford would be in the highest degree invaluable. There is an obvious reluctance, however, to show the debtor side of the account, and this is observable in a great many enterprises of note; the receipts are published with the utmost punctuality, and while money is rolling in both individuals and public companies think all must be right, the thing is paying well, and so forth.

There is no doubt the lessees of this cable will make a tolerable decent thing of it for themselves; they had a taste of the good things before they occupied their present position. But it should not be forgotten that this is public property, and that half a million of money is too serious a sum to be lost sight of, and therefore it is but reasonable they should know, or be in a position to estimate, the probability or the chances there are of refunding the original outlay, whether the lease be renewed, or it lapse into the possession of the Government to work it on a different principle; and further, it would enable the public to judge as to the wisdom and policy of Government dabbling in lines of telegraph, or whether it would not be better to leave it to general enterprise in the manner of our railways and other modern enterprises. There must necessarily be an unacquaintance with such matters in the different Government departments, which will expose them, and through them the country, to too lavish an expenditure of the public funds; and this cable is a pretty good instance of their having to pay "too dear for their whistle." It was a "Tom Tiddler's ground" for those engaged on it, whether as makers or superintendents, for they picked up plenty of gold and silver.

ATMOSPHERIC PRESSURE AS A MECHANICAL POWER.*

IN a recent article in the *Journal*, on "The Use of Air as a Motive Power in Cities," reference is made to various processes for producing a vacuum under a piston, and the inference drawn that they are all too costly, too slow, or, in other respects unsuited for obtaining a popular working force from the pressure of the atmosphere. Of others not mentioned, there is one that may be worth suggesting.

I believe there are no forces but what are designed to be employed in the arts: that all, known or unknown, are to be brought into the service of man; that Nature not only provides them, but, in her applications of them, is their best expositor, and that whatever she effects for herself with one, we can produce it by the same or analogous results for ourselves. On the present occasion, I would refer to the means by which she disturbs the equilibrium of the atmosphere, in the instantaneous condensation of vapour into rain, and the resultant ærial squalls and commotion that prevail in temperate and become so terrific in tropical latitudes. Here we perceive she is doing the very thing we want to do, employing the weight of the atmosphere as an active motive power, neutralising its influence on one spot and accumulating it on another, by forming a vacuum as it were in a cylinder, whose sides pressed together perform the part of a piston with us. Not a day, probably not an hour passes, in which these phenomena do not occur in one part of the earth or another.

The fall of rain does not appear to depend on temperature alone, since it comes down night and day in all weathers, in summer as in winter, and in the warmest climes in actual torrents. The influence of electricity over atmospheric phenomena is universally admitted, and by some, if not by all meteorologists, it is deemed the immediate cause of rain. That tempests, hurricanes, tornadoes, &c., arise from the vacuum thus suddenly produced, is still more generally conceded. They are commonly accompanied with thunder and of brief duration, subsiding as the voids become filled and the equilibrium restored. In some regions where thunder is little known, it is said there is little rain. Now, why may not artificial clouds of vapour—of low steam in a cylinder—be as quickly collapsed into water by the same means, and vacuities produced to serve our purposes as Nature produces them to serve her own? I suppose they may. If some element should be wanting in the process, it is our part to supply it. If air, for example, be found essential, a limited quantity might be admitted. If the condensation should not be effected as rapidly as anticipated, the area of the piston might be proportionally increased, and so with regard to other points. Electricity, as a science, is in its infancy. It has opened some of Nature's secrets, but they are few compared to those yet to be explained. Among them is the part it plays in the phenomenon in question. If, as is asserted, it causes the aqueous corpuscles suspended in the atmosphere to coalesce and descend, sometimes in drizzle as through the finest cullender, at others in showers of large drops, and again in sheets as if from the bursting of water-spouts, we ought to be able to bring out kindred results by it to establish the theory.

But, without reference to any theory, the object is to learn how Nature effects those sudden collapsions of vapour. Be the process what it may, mechanical or chemical, or a combination of both—whether clouds surcharged with moisture are discharged by compressure, somewhat as we squeeze a saturated sponge or wring out wet linen, or whether it be, as suspected, an electric talisman that neutralises the power that keeps the aqueous globulus apart and holds them in suspension, or anything else—when thoroughly known, we can certainly master it sufficiently to work out on

* By a Correspondent of the Journal of the Franklin Institute.

smaller scales, the same result. If, when developed, it should not be found preferable to processes we have, it is still worth finding out, were it but to determine that fact. But if, on the other hand, it should turn out much better than the best of them—simpler, cheaper, and more prompt, and there should be no obstacles to its general adoption—the benefits it would confer on our species for all time to come, would surpass those of other forces combined, steam included. It would meet almost every call for labour, for domestic and manufacturing drudgery, indoors and out. In a word, I can hardly imagine a nobler acquisition in practical science than the derivation of a general working power from the pressure of the atmosphere. A stronger stimulus to solve a great problem there cannot be.

It is, probably, in some such indirect way as this that electricity, in one or more of its forms, is to become, if ever, a popular motor, not directly, as has so often been attempted, and as often failed. Let us use it as nature does, and we are sure to succeed.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

IV.

A.D. 1851.—General Sabine, in 1851, drew the following conclusions from the magnetic observations made by the English and Russian Governments:—That the terrestrial magnetic force has periods respectively of—1. A solar day of 24 hours; 2. A solar year of 365 days; 3. Ten solar years. From this it would appear that the sun is a great magnet, and that it communicates to the earth its magnetic properties. (See *Encyclopædia Britannica*, 8th edition, art. Magnetism, p. 18.)

A.D. 1852.—Mr. John Adie, in 1852, constructed a variation compass in which the needle was suspended within a tube. Mr. Swan employed a different arrangement of the same principle. (See *Encyclopædia Britannica*, art. Magnetism, p. 80.)

A.D. 1856.—Professor Tyndall, in 1856, proved the existence of diamagnetic polarity. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 729-740.)

ELECTRICITY.

Under this head is included static or tension electricity, current electricity, and induced electricity in their various forms; also the results of combining electric force with magnetic force (electro-magnetism), with chemical action (electro-chemistry), with heat and light (electric blasting, electric light, &c.), with mechanical force (electric telegraphy, electro-motion, &c.), and with vital force (medical electricity, &c.)

The production or development of electric force in nature, and its existence and use prior to the researches of man, will be evident to most minds; the following examples bear upon this point:—*Static or tension electricity* in the form of lightning; *current electricity*, as developed by galvanic circuits acting in the natural formation of minerals, also as developed by thermo-electric circuits formed by the unequal temperature of the earth; and *induced electricity* (developed by other electric currents and by terrestrial magnetic force in conjunction with mechanical motion), believed by many astronomers to be included in the category of forces which bind planets to their primary, and system to system. As in magnetism, electricity was first believed to belong to one body exclusively, viz., amber; other "electricts" (as glass, resin, sulphur, &c., all non-conductors) were next recognised; it is now, in its various forms, known to pervade the whole of nature, and to administer silently but effectually to the wants of man.

Holy Writ makes mention of lightning in the following passages:—*Exodus* xix. 16; 2 *Samuel* xxii. 15; *Job* xxxvii. 3; xxxviii. 25; xxxviii. 35; *Psalms* xviii. 14; lxxvii. 18; xcvii. 4; cxxxv. 7; cxliv. 6: *Jeremiah* x. 13; li. 16; *Ezekiel* i. 13, 14: *Daniel* x. 6; *Matthew*, xxiv. 27; *Luke* xvii. 24; *Revelations* iv. 5; xi. 19. Thunder is mentioned in the following passages:—*Exodus* ix. 23, 28, 29, 33; xix. 16; xx. 18; 1 *Samuel* vii. 10; xii. 17, 18; 2 *Samuel*, xxii. 14; *Job* xxvi. 14; xxxvii. 5; xl. 9; *Psalms* xviii. 13; lxxvii. 18; lxxxi. 7; civ. 7; *Isaiah* xxix. 6; *Mark* iii. 17; *John* xii. 29; *Revelations* vi. 1; x. 3; xix. 6. The wonderful passage from *Job* xxxviii. 35, "Canst thou send lightnings, that they may go, and say unto thee, Here we are!" (original Hebrew, "Behold us!") seems almost prophetic, when viewed in connection with the electric telegraph.

B.C. 600.—The Etruscans (about 600 B.C.) devoted themselves to the study of atmospheric phenomena in an especial manner, and divided the lightnings into those that came from the earth and those that came from the sky; they are said to have drawn down lightning. (See De la Rive's *Treatise on Electricity*, Vol. III., p. 90; also *Encyclopædia Britannica*, 8th edition, art. Etruscans or Tuscans, pp. 355-361.)

B.C. 600.—Thales, about 600 B.C., is reported by subsequent writers to have described the power of attracting light bodies which is developed in amber by friction. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 41.)

B.C. 341.—Aristotle, about 341 B.C., records that the torpedo "causes or produces a torpor upon those fishes it is about to seize, and having by that means got them into its mouth, feeds upon them." He further adds that this fish "hides itself in the sand and mud, and catches those fish that swim over it by benumbing them, and of this some have been eye-witnesses. The same fish has also the power of benumbing men." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 41; also *Encyclpaedia Britannica*, p. 530.)

B.C. 321.—Theophrastus, about 321 B.C., mentions that the "lyncurium" (tourmaline?) has similar properties to amber in regard to the attraction of light bodies. Beckmann thinks the "lyncurium" was not tourmaline, but more likely to have been the hyacinth. (See *Encyclopædia Britannica*, 8th edition, art. Electricity, p. 529; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 41; also Beckmann's *History of Inventions*, Vol. I., pp. 86-98.)

A.D. 50.—Scribonius Largus (A.D. 50) relates that Anthero, a freedman of Tiberius, was cured of the gout by the shocks of the torpedo. See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 41.)

A.D. 1160.—Eustathius, Bishop of Thessalonica (A.D. 1160), in the scholia upon Homer, relates that, "Walimer, the father of Theodoric, who conquered, as they say, the whole of Italy, used to emit sparks from his own body; and a certain ancient philosopher says of himself, that once, when he was dressing and undressing himself, sudden sparks were emitted occasionally, crackling; and sometimes, he says, entire flames blazed from him, not burning his garments. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 41, 42.)

A.D. 1600.—Dr. Gilbert, in his work "De Magnete," published A.D. 1600, adds several substances besides amber to the list of electrics, and states that not only light bodies, but all solid bodies whatever, including metals, water, and oil, are attracted by excited electrics. "These experiments he directs to be performed by bringing the excited body near to the end of a light needle of any metal balanced, and turning freely on a pivot like the magnetic apparatus." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 42.)

A.D. 1617.—Strada, in 1617, published his "Prolusiones Academicæ." In one of these he speaks of a suppositious means of communication between two friends at a distance from each other. "Strada's fancy was this: there is, he supposes, a species of loadstone which possesses such virtue that if two needles be touched with it, and then balanced on separate pivots, and the one be turned in a particular direction, the other will sympathetically move parallel to it. He then directs each of these needles to be poised and mounted on a dial having the letters of the alphabet arranged round it. Accordingly, if one person has one of the dials and another the other by a little pre-arrangement as to details, a correspondence can be maintained between them at any distance by simply pointing the needles to the letters of the required words." A free translation of the poem, in English heroics, was published in 1750, in "The Student, or the Oxford and Cambridge Miscellany," signed Misographos. (See *Saturday Review*, August 21, 1858, p. 190; also Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 58, 59.)

A.D. 1675.—Boyle, in his "Experiments and Notes about the Mechanical Origin of Electricity," published in 1675, states that warming the electric increases the electrical effect. He also added to the list of electrics, and "ascertained that the converse of all the experiments upon the relative motion of the attracted and attracting body was also true; namely, that if the substance to be attracted were fixed, and the excited electric capable of motion, their union would still take place." (See *Encyclopædia Metropolitana*, Vol IV., art. Electricity, pp. 42, 43.)

A.D. 1675.—Newton, in the year 1675, communicated to the Royal Society the fact that when a plate of glass is excited on one side, the other side also becomes electrical. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 43.)

REPORT OF THE DIRECTORS OF THE SUBMARINE TELEGRAPH COMPANY.

THE directors have much satisfaction in submitting the annexed accounts to the shareholders. It will be observed, on comparing them with the accounts for the corresponding half-year of 1863, that the receipts have increased by £1,737 1*s.* 11½*d.*, and that the expenses are less by £631 6*s.* 4½*d.* The revenue has been charged, as usual, with 10 per cent. on the gross receipts, equal to £2,388 2*s.* 6*d.*, for the reserve fund, which now amounts to £8,907 2*s.* 10*d.* The result enables the directors to recommend a dividend at the rate of 5 per cent. per annum, or of 2½ per cent. for the half-year, instead of 2 per cent., as paid for the six months ending June, 1863. It should be noticed that the sum standing to the credit of the reserve fund, in December last, has been invested in debentures of the North Eastern Railway Company, and Charing Cross Railway Company.

The directors have to inform the shareholders that the Belgian Government has demanded, in accordance with the terms of the Concession, a larger number of wires to London; and, consequently, the directors have laid a branch cable of about twenty miles in length, from the present Ostend cable to the English shore near Ramsgate. This cable has been laid by contract since 30th June, and will be in working order as soon as the land lines are completed. The cost of it, which is about £11,100, will be charged to capital, and will bear its proportion in the distribution of the future nett profits between the Chartered and French companies. The contractor has received, in part payment, debentures bearing 6 per cent. interest to the amount of £4,000, and the directors, considering the present satisfactory state, and the steadily increasing prosperity of the Company, believe that the balance will be also taken up in debentures, either by the shareholders or the public.

By order, S. M. CLARE, Secretary.

THE SUBMARINE TELEGRAPH COMPANY BETWEEN GREAT BRITAIN AND THE CONTINENT OF EUROPE (CHARTERED), AND THE SUBMARINE TELEGRAPH COMPANY BETWEEN FRANCE AND ENGLAND, SOCIETE CARMICHAEL ET CIE.

STATEMENT OF JOINT EARNINGS FOR THE HALF-YEAR ENDING 30TH JUNE, 1864.

Dr.

	£	s.	d.
To amount received for messages	23,881	4	8
	£23,881	4	8

Cr.

	£	s.	d.
By salaries and wages	4,836	16	5
„ general charges, including clothing, postages, auditors' fees, maintenance of batteries, and incidental expenses	861	16	9
„ rent, rates, taxes, gas, and insurance	665	15	9½
„ stationery, printing, and advertisements	355	0	10
„ traveling expenses	272	8	3
„ law charges	137	2	2
„ repairs to cables	3,516	2	7
„ reserved fund, 10 per cent. on gross receipts, £23,881 4s. 8d.	2,388	2	6
„ Profit.— Chartered Company's proportion ......£8,584 14 4½; French Company's proportion 2,263 5 0	10,847	19	4½
	£23,881	4	8

JOINT BALANCE SHEET.

	£	s.	d.
To sundry creditors, including sums owing to the Continental administrations	45,058	9	5½
Reserve fund:— 31st December, 1863 ......£6,441 7 0; Interest thereon ...... 77 13 4; £6,519 0 4; Addition for 30th June, 1864 .. 2,388 2 6	8,907	2	10
To balance, profit for half-year, as per revenue account	10,847	19	4½
	£64,813	11	8

	£	s.	d.
By sundry debtors	17,797	10	4½
„ cash at bankers and in office ......£2,770 16 0½; „ cash on deposit 27,000 0 0	29,770	16	0½
„ furniture, stores, batteries, and instruments, in London and out-stations	6,147	17	0
„ debentures:— North Eastern Railway ....£4,000 0 0; „ debentures — Charing Cross Railway ......2,500 0 0 (Reserve fund)	6,500	0	0
„ Magnetic Company's stock	780	0	0
„ capital	3,817	8	3
	£64,813	11	8

REVENUE ACCOUNT OF THE CHARTERED COMPANY FOR THE HALF-YEAR ENDING 30TH JUNE, 1864.

	£	s.	d.
To proportion of receipts	8,584	14	4½
„ balance from last account	774	13	9½
	£9,359	8	2

	£	s.	d.
By direction	500	0	0
„ charges	156	14	10
„ interest on debentures	1,744	12	4
„ proposed dividend at the rate of 5 per cent. per ann.	6,625	0	0
„ balance to new account	333	1	0
	£9,359	8	2

BALANCE SHEET.

	£	s.	d.
To capital	265,000	0	0
„ debenture bonds:— Authorised issue, one-third of £265,000 ..£88,333 6 8; Less unissued 32,138 6 8	56,195	0	0
„ interest on debenture bonds	1,205	12	9
„ dividends unpaid	618	10	2
„ revenue	3,817	8	3
„ proposed dividend	6,625	0	0
„ balance to new account	333	1	0
	£333,794	12	2

	£	s.	d.
By sum expended on capital account	320,012	8	3
„ sundry debtors, including caution money deposited with foreign governments	5,197	9	6½
„ proportion of receipts for the half-year	8,584	14	4½
	£333,794	12	2

Examined, compared with the books and vouchers, and found correct, August 15th, 1864,

GEORGE COPELAND CAPPER, WILLIAM R. COLE, THOMAS DAKIN, } AUDITORS.

TELEGRAPH CLERKS' FUND.

THE following address was delivered by Mr. John Young at the conversazione given by the above Fund on the 8th inst., and which was referred to in our account of the entertainment last week:—

In looking back at the days of our childhood we can well remember the occasions when indulgence in cake, toffee, and unripe apples has caused indigestion and a thousand other ills to which our flesh is heir. But the remedy which became our fate on these occasions is still more firmly impressed on our recollection, and we can vividly recall the powder which became our fate—not in its scruple form, but cunningly disguised in a spoonful of jam so that the bitter, though wholesome, medicine was masked beneath the seductive currant and raspberry. Our meeting this evening is not altogether unlike the powder concealed in the jam. Our object in thus assembling is to lay before you the claims of the institution to which our chairman has already adverted, but as this might have been considered a somewhat bitter pill of itself, we decided that songs, recitations, and music should be provided as alteratives to the more serious business of the evening. I will promise to make my dose as small as possible, and when you consider the reward you will have in the vocalization of our fair friends, you will bear the infliction in good part.

You are aware that this is the sole institution of any kind open to telegraph clerks generally. Its objects are to afford medical advice, medicines, and pay in sickness, a provision for old age, and a sum of money at death. When we consider the number of persons who compose our profession it becomes a matter of wonder that there should be but a single institution of this nature among us and that one so partially supported. I have long endeavoured to find the reason for this. Are we as a rule indifferent to our best interests? or is it the nature of the telegraph clerk to be reckless and improvident? A moment's thought must convince one and all of us that it is our bounden duty and incumbent upon each of us to make some provision for a rainy day—ill health may overcome the most robust among us. I remember when the first lot of members was enrolled, one of them on being asked when ill last, replied, "Never!" It seemed almost needless for this person to make a provision, but he did so, and within a month was seized with a severe illness that lasted many weeks. You can deduce your own moral here. It is indeed hard in times of ill health to find all sources of income stopped, and thus be debarred from those comforts and even necessaries which are then so urgently required. Believe me, my friends, the only means by which persons of limited resources like ourselves can make any provision of this nature is co-operation! There is much philosophy in the divine precept, "Bear one another's burdens," for in promoting the welfare of those around us we secure in like proportion our own prosperity and happiness. It is to be deplored that so much apathy and indifference should exist among us; we look too much for extraneous support; we want too much assistance from others, and yield too little ourselves; the best help is self-help—it is more effective and confers no obligation. Not that I would for one moment undervalue the assistance we have received from those ladies, headed by the second in the land, or that of several gentlemen, bright ornaments of society, and who amid the more onerous claims of parliamentary, social and scientific duties, have lent a helping hand to our cause. It is very gratifying to observe the names of so many telegraph directors among the patrons of the institution, and the good feeling and generosity thus evinced will give rise in no measured

degree to corresponding feelings of gratitude and increased diligence on the part of those employed. Labour and capital must ever be intimately associated, and whatever promotes the prosperity of the one advances the interests of the other. I cannot withhold myself from referring to the gentleman who occupies the chair this evening. Among many pressing engagements, and at a considerable sacrifice of leisure, he has devoted much time and attention to our objects, and demands not only the thanks of the members themselves but of every telegraph clerk whom he has sought to benefit. But it is no use for friends and well-wishers to labour for us if we are idle ourselves. I would earnestly urge each and all of you to be "up and doing," to co-operate for our mutual benefit. With common cause and common action much might be done to promote our prospects and interests. Let each put his shoulder to the wheel and advance by every means in his power the welfare and prosperity of the telegraph clerk.

THE PERSIAN GULF TELEGRAPH.

(*Concluded from page* 93.)

There remained one or two splices to make ashore to complete the land portion from the landed end to the floating office at Fau. These were all completed by the evening of the 8th, and at 5.30 p.m. of that date Fau spoke through to Bushire, and thus Fau and Bussorah could telegraph to Kurrachee and Bombay.

There remained yet the section between Gwador and Cape Mons (near Kurrachee) to lay, and as the sea-bed is excessively steep there, deepening from twenty or thirty fathoms to five or six hundred in the space of half a mile, it was one requiring special care; besides which the cable remaining in the Assaye, together with all the main cable in the Cospatrick, was eventually expended on this section without reaching Cape Mons, so that two ends had to be buoyed.

The unsatisfactory state of the land lines between Bussorah and Bagdad, and the complication of political affairs connected with it, required the presence of Colonel Stuart and Sir C. Bright at Bagdad, and the operation of laying this last section was, therefore, entrusted by Colonel Stuart and Sir C. Bright to the superintendence of Mr. F. C. Webb, Mr. J. C. Laws being in charge of the electrical department.

On the 12th, all arrangements having been made, and all the necessary official orders issued, the Coromandel, with Colonel Stewart, Captain Stewart, Sir C. Bright, Colonel Pelly, and Colonel Goldsmid, left for Bussorah. On the evening of the 13th the Zenobia, with the Assaye and Said in tow (to save coal) steamed for Bushire, the Amberwitch having started the same day. On the 15th the Assaye reached the Bushire Roads, and started again on the 16th, and arrived off Luiga on the evening of the 18th. The Zenobia then went to Bassidora (distant about seventeen miles) to coal, and left Luiga on the 24th, with the Assaye in tow, calling at Mussendom, and arriving at Gwador (East Bay) on the 28th. In the meantime the Amberwitch had preceded her with Mr. Webb on board, and arrangements were made for the landing of the end.

The shore end for this section was on board the Amberwitch, which ship was accordingly anchored about half a mile from the shore, and cable coiled from her into the paddle-box boats. A heavy S.W. swell rolled now round the point into the bay, causing the Assaye and Zenobia to roll very heavily, and it was not until the 30th that the latter vessel could attempt to coal. On the 30th, at daylight, the Amberwitch was moved nearer to the shore, and the shore end payed out from the boats to the shore and safely landed. The Amberwitch was then steamed out towards the Assaye, paying out cable as she went, and then hung stern to stern to the Assaye, which ship was three miles and a half distant from the beach. One mile and a half of shore end was then turned over on board the Amberwitch, and the next morning (the 1st of March) this was cut, and the end passed on board the Assaye, and joined on, by means of a taper and two splices, to the cable on board the Assaye; the whole of this one mile and a half was then hauled on board the Assaye, and coiled down on the tops of the rest of the cable, and the bight let go from the Amberwitch at 4 p.m., thus leaving the Assaye with five miles of shore end spliced on to her main cable, and the end safely landed. This was the first case where the shore end of a section about to be laid was payed out from the shore to the large ships, instead of *vice versâ*. The necessary arrangements had then been made between Mr. Webb and Lieutenant Carpendale (the senior naval officer), Commander Bradshaw, R.N. (surveyor), Lieutenant Stiffe and Mr. Young (surveyor), as to the buoying of the course. The Amberwitch was to go on ahead, and take up certain positions indicated on the chart, hoisting a blue ensign at the main when in position by day, and burning blue lights and exhibiting three fixed lights at night.

The hour of departure was arranged to be 4 p.m. of the 2nd, in order to make a dangerous rock near the course of the cable by daylight, but this was altered to 4 p.m. of the following day (the 3rd), on account of some operation to the land line which had to be performed on the shore.

On the 3rd, at 4 p.m., the Zenobia took the Assaye in tow, and at 5 p.m. paying out again commenced, the Amberwitch having started several hours before, and gone on ahead to take up her position, No. 1. At about 10 p.m. the blue lights of the Amberwitch, in position No. 1, were sighted, and the Zenobia steered out towards her.

There was a good deal of swell on, and as the ships pitched the cable jerked, as it generally does in shoal water when there is any sea on. A little after daylight Astola Island was sighted, and the Amberwitch took up position No. 2, which was passed about 8 a.m.

The Amberwitch, in position No. 3, was passed about noon; No. 4, about 4 p.m.; and she was sighted taking up her position, No. 5, about 6.30. During all this time the paying out had proceeded beautifully, the cable sweeping grandly round the tall cone in the middle of the magnificent main coil of the Assaye.

And now came one of the most exciting incidents of the whole cruise. About 7 p.m., with very little warning, the ships were struck by a tremendous squall from the W.N.W., accompanied by rain, lightning, and a fearful quantity of fine sand which enveloped everything in the most solid darkness. So intense was the obscurity that although, from the Assaye being driven nearly on to the Zerobia, that ship was close under the bows of the Assaye, not a vestige of her lights could be perceived from the Assaye. Just before the total eclipse as the squall came, the message "Webb to Carpendale—Don't get blown into deep water" was sent, and then all signalling was at an end, and everything total darkness. Both ships "broached to" and headed in for the land, in spite of their helms being hand up. The full force of the wind came on them thus right on the beam. The awning of the Assaye was caught underneath by the wind, and bellying up in an arch nearly as high as the mizen-top, carried away with a report like a gun, snapping all the stormy and heavy iron stanchions to which the ridge-chain was secured, carrying them up right over the paying-out gear, and dashing them down on the deck, but most fortunately without doing any injury to life or limb. The break was completely buried in the wreck, but was fortunately cleared without any rope or chain getting foul round the cable or being carried into the revolving machinery, although for some time the ridge-chain was actually resting on the drum of the break, which was revolving at the rate of forty-five revolutions a minute, indicating that the ship was driving along at the rate of eight knots and a half an hour, and the cable paying out at that rate. This was a pretty good test for the mechanical arrangements, which continued to act, however, as perfectly as if the ships had only been going three knots. The wind lessened a good deal by about 8 p.m., and it became possible to speak to the Zenobia by the telegraph lamps. The first question from the Zenobia was, "Have you cast off your hawsers?" and the answer, "No, and we don't intend to." The necessary arrangements were then telegraphed from Mr. Webb, in the Assaye, to Lieutenant Carpendale for rounding the ships to, head to wind, previous to buoying the end. The first blue light from the Assaye was to indicate "Only one mile left in the ship," and the Zenobia was then to starboard her helm, and round the ships to, head to wind, so as to have the ships under command as to speed. The wind nearly all died away, however, by ten, and what little there was left had shifted to N.N.E., so that it required a very slight alteration of course to bring the ships head to wind. When about half a mile only was left, the Zenobia was signalled to ease, and then stop, and the foresail of the Assaye was dropped, so as to check the way of the ships. When nearly entirely stopped the breaks were lifted, and the break-wheel handed round by main force, so as to slacken the cable over the stern, and then the breaks were put down for a moment, and the stray-chain leading to the mushroom anchor bent on to the cable, and the anchor and buoy let go, another blue light announcing this to the Zenobia. The ship then had way given her once more, and when only a few turns were left in the hold she was again eased, so that when she finally stopped the end was close to the break. The stray-chain of the next buoy was then attached to the cable, and the end, anchor, and buoy let go in succession, a rocket from the Assaye at the same instant announcing to the Zenobia that the end was safely buoyed. A flag buoy was then let go, as the Amberwitch, which was to have done this, had parted company with the other ships in the darkness during the squall.

Thus ended the laying of the Assaye's portion of the Gwador and Kurrachee section, about 159·81 miles, leaving the end about 27 miles eastward of Osmarro. The ships then steered for Osmarro, going slowly, in order to make the bay only at daylight; and the bay was entered at 8 a.m. of the 5th of May by the Zenobia, Assaye, and Amberwitch. This was the rendezvous appointed for meeting the Semiramis, with the Cospatrick and the Sind, which ships were to bring stores from Kurrachee. The Sind arrived that same day, and during the day all spare pieces of cable were transhipped into the Amberwitch from the Assaye, and the machinery of the Assaye was pulled down and struck below.

On the 7th the Semiranis arrived at 8.30 a.m. with the Cospatrick in tow, and that day was employed in preparing the latter vessel finally for the reception of men and stores, &c. On this evening another very sudden and heavy squall, with heavy rain, was experienced. On the 9th Mr. Webb, in the Amberwitch, proceeded to sea to find the buoys on the end, it having been arranged that the Cospatrick should be brought out by the Zenobia on the following morning (the 10th), and anchored near the Amberwitch, so that the end of the submerged cable might be passed by the Amberwitch to the Cospatrick, and then spliced on to the cable in that ship. The flag buoy and buoy on the bight were found by the Amberwitch on the 9th, and the ships anchored near them; but the buoy on the end was gone. On the morning of the 10th the buoy on the bight was weighed, and the short piece between this point and the end buoyed and let go, and sufficient cable wound into the Amberwitch to veer and haul on. Meantime the Zenobia had brought out the Cospatrick, and that ship was anchored near the Amberwitch. The Amberwitch was then steamed up under the stern of the Cospatrick, paying out cable from her bow sheave as she went, and then hung

by a hawser to the Cospatrick. The end was then passed in at the stern and sheave of the Cospatrick, and the Amberwitch cast off. The joint was then attempted, but the same difficulty which has been alluded to before as having occurred when attempting to make the joint during the repairing expedition was here experienced, and it was found impossible to make a joint. The end was accordingly passed back to the Amberwitch, and "picking up" cable was commenced at 8.30 p.m. in the hope of finding some place where the gutta-percha was more docile. At 10 p.m. the Amberwitch was anchored, and picking up resumed the next morning at daylight until 11 p.m. of the 11th, when ten miles having been picked up, and the cable cut every half mile without any success, a consultation was held, when Mr. Laws suggested the following plan for overcoming the difficulties, which was employed with success. It was evident that the air which forced the warm gutta-percha into bubbles came from whatever minute spaces existed between the copper and gutta-percha, and that the air was forced up by the hydrostatic pressure acting on the submerged gutta-percha. If, therefore, the core could be choked or strangled, as it were, close to the part to be joined, so as to confine the air within the cable, the difficulty would be overcome. The plan proposed by Mr. Laws was to put two grooved clasps of wood round the core, and by binding them tightly together so as to squeeze the gutta-percha tightly against the copper conductor for a space of four or five inches. The plan was tried and answered perfectly, and an experimental joint was made to test it. The next morning (the 12th) some more cable was wound in the Amberwitch to veer and haul by, and the Cospatrick was anchored on the starboard beam, and the end once more passed on board the Cospatrick. A joint was then begun according to Mr. Laws' plan, and accomplished without any difficulty. The splice was then commenced, and at 4 p.m., all being ready, the Zenobia anchored ahead of the Cospatrick and passed hawsers. At 5 p.m. the ships got under weigh, and paying out commenced again. This proceeded throughout the night of the 12th, the ship going over the ground, when the tide was with her, at the rate of 6·27 knots an hour, the Anberwitch keeping ahead and on the bow of the Zenobia, and sounding constantly, and signalling to the Zenobia the depth. About 8 a.m. of the 13th nearly all the main cable available in the Cospatrick (eighty-six miles) was expended, and the necessary arrangements for rounding to and buoying the end telegraphed from the Cospatrick to the Zenobia. At 9 a.m., all but about a mile being expended, the Zenobia was rounded to head to wind, which was from the westward. The foresail of the Cospatrick was then dropped, and thus the vessel was completely under command. The bight was first buoyed and then the end buoyed and let go, about ten miles from the landing-place at Cape Moiree. About this time the Sind arrived from Kurrachee, having on board Sir C. Bright, who had, with Colonel Stewart, arrived at Kurrachee from Bagdad in the Coromandel the day before. The Zenobia then cast off the Cospatrick, which ship was then taken in tow by the Sind, and towed to Kurrachee; Sir C. Bright, Mr. Laws, Mr. Webb, and Mr. Woods taking passage in the Amberwitch, to complete the section by landing the shore end, and paying out cable to the end just buoyed. The Zenobia and Amberwitch then steamed to Cherna Island (an island a few miles from the proposed landing-place), and anchored under the lee of the island for the night, and during the night the shore end was coiled from the Amberwitch into the paddle-box boats.

On the morning of the 14th the Amberwitch was taken opposite the landing-place and anchored. A good bit of swell rolled into the bay, and the wind being from the westward made the beach where the end was to be landed a dead lee shore.

The two paddle-box boats, filled as usual with cable and towed by a cutter, started about 9 a.m. for the beach, paying out cable as they went. The swell at the entrance to the bay was considerable, and threatened every minute to dash the paddle-box boats against one another. This was only prevented by holding on to the telegraph cable, by the stoppers at each "send," and then slacking away at the proper instant; at last one boat was emptied and cast off, and the other was soon afterwards beached and the end safely landed.

With some difficulty all the boats were got back safe to the ships. The Amberwitch was then got under weigh, and payed out cable for four miles out, and then anchored to finish splicing up some more cable, which it was thought would be required to reach the buoys on the end buoyed from the Cospatrick.

On the 18th, at 7 a.m., paying out towards the buoys was resumed from the Amberwitch.

When the buoys were reached the Amberwitch was anchored, and the cable passed forward, and in at the bow and heave. The ship was then again got under weigh, and the buoy on the sea end picked up and the end brought on board. The final splice of all was then commenced and let go at 4 p.m., thus completing, for the present, the Persian Gulf telegraph cable.

On the 16th the Amberwitch came into Kurrachee. On the 17th a dinner was given on board the Cospatrick, at which were present Sir C. Bright, Colonel Pelly, Captain Stewart, Commander Bradshaw, R.N., Lieutenant Carpendale and lady, Lieutenant Stiffe and lady, Captain Elmslie and lady, Mr. Young, Dr. Adair, Mr. F. C. Webb, Mr. Brasher, Mr. Alexander, and many others. Colonel Stewart, having unfortunately a previous engagement, was unable to be present, and Mr. Laws, Mr. Lambert, and Mr. Woods were also unfortunately absent.

On the 18th Colonel Stewart, Sir C. Bright, Mr. Laws, and Mr. F. C. Webb, and the rest of Sir C. Bright's staff, started in the Coromandel for Bombay, where they arrived on the evening of the 20th.

On the 24th Sir C. Bright, Mr. Laws, and the rest of Sir C. Bright's staff, excepting Mr. F. C. Webb, started for England. The latter gentleman remains, on the part of the Government, in engineering charge of the line until June, 1868, and during that time it is proposed to lay a very heavy double wire shore-end cable off Bushire instead of the present separate single cable, and it is possible that the station at Mussendum may have to be shifted to some other locality, as it is feared that the extreme heat of Mussendum will be too much for the clerks employed. Colonel Stewart left by the mail on the 24th of June for Constantinople. The Cospatrick discharged all her cargo of miscellaneous cable, consisting of the Bushire heavy shore-end, and various pieces of ordinary shore-end, main cable, and experimental cable into the tank built for that purpose at Kurrachee, and arrived under sail at Kurrachee on the 16th of June, and is now the only vessel of the five sailing ships that has not been yet discharged from Government employ, the Assaye having gone out of dry dock on the 5th, and discharged from Government employ on the 6th. The Amberwitch is still at Bombay, but will shortly return to Kurrachee.

The Persian Gulf cable was commenced in February, 1863, and the whole work has therefore lasted about sixteen months.

Nothing could be more satisfactory than the way all the arrangements for laying the cable have succeeded, and in giving credit to those who have had the management of it, it should be borne in mind that no very long cables have before been successfully laid from sailing vessels in tow, although several times before the operation has been attempted; and many who are supposed to be the very best judges in such matters prophesied utter failure.

The whole work was carried out by the Government through Colonel Stewart and the civil engineers, Messrs. Bright and Clark, and naval officers appointed by him, without letting the laying of the cable by contract to large contractors, and thus the large premiums which would have been paid to contractors for taking the risk of laying has been saved at the expense of a few thousand pounds to a firm of civil engineers, who provided the whole of the staff for testing the core and superintending and testing the cable during manufacture, designing the machinery, fitting out the ships, coiling the cable on board, and finally laying it. But in addition to the actual saving to the Government, the work, there can be no doubt, has been done in a much more satisfactory manner as regards its permanence than if it had been done by contract, in which case the saving of expense to the contractors is the principle that rules the whole proceedings.

It was also remarked by all those who, as engineers or electricians, have often been engaged before on large works of this description let by contract, where the ships and all are under the contractor, that there was, during the whole work, an entire absence of all those annoying party feelings and business quarrels which have invariably taken place on the previous expeditions, where the contractors' electricians have been at loggerheads with the Government or company's electricians, and both sets of electricians have been perpetually sneering at the engineers, and *vice versâ*, while the contractor himself, setting all Government engineers and electricians at defiance, and being in his own ships, and consequently, as it were, on his own territory, manages to make everybody in general tolerably miserable and uncomfortable.

On the Persian Gulf expedition none of these disagreeables were experienced, and as all, including naval and military officers, civil engineers, and electricians pulled together with only one interest—viz., the success of the work, and acting as they did under the authority of an officer at once skilled, courteous, considerate, and patient, the whole work, though quite as arduous as any other, was rendered so free from the annoyances common to most previous expeditions that few, we think, will remember the time they were employed on the Persian Gulf cable expedition with any other feeling but that of pleasure.

HALF-YEARLY MEETING OF THE SUBMARINE TELEGRAPH COMPANY.

THE half-yearly ordinary meeting of the shareholders of the Submarine Telegraph Company (between Great Britain and the Continent of Europe), was held at the London Tavern, Bishopsgate-street, on Tuesday, for the consideration of the accounts and balance-sheet, and the report of the directors for the half-year ending 30th June last, and for the declaration of a dividend. The following directors of the company were present:—Sir James Carmichael, Bart., the chairman (who presided over the meeting), C. Saunderson, Esq., and G. Scamell, Esq.; Mr. France, engineer, and Mr. Campbell (of Messrs. Davies, Son, Campbell, and Reeves), solicitor of the company, were also present.

At one o'clock there not being a quorum present, the meeting was delayed a few minutes, until two or three shareholders were sent for to constitute a legal meeting. At length, the requisite number being present,

The CHAIRMAN called on the secretary to read the advertisement convening the meeting.

Mr. S. M. CLARE, the secretary, then read the advertisement by which the meeting was convened.

The chairman having affixed the seal of the company to the register of shareholders, the report and statement of accounts, which had been circulated amongst the proprietors, were taken as read.

The Chairman said, in moving the adoption of the report he had much pleasure in congratulating the shareholders on the improved position of their affairs since they last met together, and he thought they might consider the returns now laid before them as very satisfactory; and particularly so when it was remembered that their receipts had been earned almost entirely on their French and Belgian cables, because, unfortunately, owing to the war carried on in Schleswig and Holstein their Danish cable had not been used,—it had remained intact,—it had been treated with the utmost respect, but business on it had been suspended, and they had received almost nothing from Denmark. And from the Hanover line their receipts had been absolutely nothing. Their principal income had been derived from the Belgian and French cables. To show the rapid progress of the company he would refer to the increase in the number of messages carried on the French and Belgian cables: for the half-year ending 30th June, 1864, the number of messages transmitted was 180,000, as against 160,404 messages for the half-year ending 30th, June, 1863. That, he thought, showed a very gratifying increase. And he might go still further and say, that in the present half-year, notwithstanding the existence of the present state of things in Denmark and Hanover, they were earning in excess of the last half-year at the rate of £100 per week. (Hear, hear.) He hoped that no long time would elapse before the state of affairs in Schleswig-Holstein would be so settled that they should be able to get back their earnings from Denmark. He trusted that in a short time a government would settle down where lately there had been so much disturbance, and that to whichever party they might have to apply, whether to Prussia on one side or to another, the company should have a return of their business with Hamburg, North Germany, and Denmark. To have got an increase of business under the circumstances was, in his opinion, a very encouraging state of things. As to the new line, from near the North Foreland to nearly twenty miles out, to join the Belgian line, they were bound by the terms of the concession to lay down additional wires to Belgium whenever the Belgian government thought it beneficial to themselves and to the company to put down such additional wires. From increased business with Belgium and Vienna the Belgian Government considered it was necessary to have additional wires, and, accordingly, they called on the company last year to put down another cable, so that there should be two cables between Belgium and England, and that there should be no interruption of communication between the two countries. The directors entered into negociations with the Belgian government on the subject, pointed out to them that beyond twenty miles from the North Foreland no interruption of communication took place, or was likely to take place, and suggested to them that if the company could come to an arrangement to secure efficient communication by laying down a branch cable of about twenty miles in length, instead of putting down a second cable the whole distance, it would be unreasonable in them to ask the company to put down a second line. He went over to Belgium for the purpose of carrying on the negociations, and he was happy to say that the Belgian government met the propositions of the company in a very fair and liberal spirit. All they said was that they were desirous of keeping up their character and prestige, so that there should be no interruption of communication with the Austro-German Union. It was explained that by the plan of the company, if the main line was injured within the distance mentioned, by joining up the loop with the main line interruption of communication would be prevented, and if anything injurious happened to the loop line there would be the main line to fall back upon. The Belgian engineer, M. Vinchent, fell in with the proposition of the company, which was agreed to by all parties concerned; and at a cost of £11,000, instead of laying out £50,000 or £60,000 in the construction of a new cable, a second line of communication had been made with Belgium. And he thought the outlay would be productive, because, as the direct route would not be interrupted, they would not have, as they had occasionally to do for weeks together, to send messages round by the more circuitous route of France, by which the company was put to additional expense and the public to inconvenience by delay. He thought the arrangement which had been made was a very favourable one to the company. He had much pleasure in moving that the report and statement of accounts be received and adopted.

Mr. Hindmarsh seconded the motion.

Mr. Squire asked what was the amount paid to the Magnetic Company?

Mr. Clare, the secretary, stated that it was one-fifth on the London, and two-fifths on the provincial and Irish business.

Mr. Squire thought they were making a poor income out of their submarine wires. The Electric and International Company made a submarine cable pay 25 per cent.

The Secretary—Has that statement appeared?

Mr. Squire said that he believed that statement had been made and appeared.

A Shareholder said that the Electric and International Company made a cable pay 25 per cent. in six months.

The Chairman and the Secretary thought there must be some mistake.

Mr. Bevan thought they had good reason to congratulate the directors on the excellent manner in which they had managed the affairs of the company. The directors had had many difficulties to encounter; they had had up-hill work to undergo in the management of the affairs of the company, and they had done all they could to rescue the company out of its difficulties. It was gratifying now to find that the directors recommended the declaration of a dividend at the rate of 5 per cent. per annum; that was a gratifying circumstance, and the shareholders might look hopefully to the future, and expect in a very few years to receive a return that would amply compensate them for the money they had invested in the undertaking. He hoped that the directors would avoid all unnecessary expenditure on new lines. As the chairman explained, the expenditure of £11,000 on a branch Belgium cable proved unavoidable, as the Belgian Government appeared to have a right to demand that that expenditure should take place. But he should like to see all unnecessary expenditure avoided, and looked forward to the time when they should have a dividend, not simply of 5 per cent., but of 7½ or 10 per cent.

The motion for the adoption of the report and statement of accounts was then unanimously agreed to.

The Chairman moved—"That a dividend for the half-year ending the 30th of June, 1864, at the rate of 5 per cent. per annum, less income-tax, be declared, and that it be payable on and after the 12th of September next."

The Rev. W. Horton seconded the motion referring to the declaration of a dividend. He very much concurred in the observations of the gentleman on his right hand (Mr. Bevan) as to the encouraging aspect of the affairs of the company. He did think they had now succeeded in overcoming the most formidable difficulties they had to grapple with, and it appeared to him the prospects of the company were now brighter than he ever knew them to be before. He felt very great confidence in the wisdom with which the affairs of the company were managed, and he quite coincided in the congratulations presented to the directors that they were prepared to propose a dividend at the rate of 5 per cent. per annum.

The motion was carried unanimously.

The Chairman moved, that the retiring directors, Lord De Mauley, Samuel Gurney, Esq., M.P., and Captain Grant be re-elected.

The Rev. W. Horton seconded the motion.

Carried unanimously.

The Chairman moved, that the retiring auditors, George Copeland Capper, Esq., William Cole, Esq., and Mr. Alderman Dakin, be re-elected.

The motion was seconded by Mr. Hindmarsh, and agreed to.

A vote of thanks having been accorded to the chairman, the meeting broke up.

HALF-YEARLY MEETING OF THE UNIVERSAL PRIVATE TELEGRAPH COMPANY.

A General Meeting of the shareholders of this company was held at the offices, Adelaide-street, West Strand, on Wednesday afternoon, to consider a recommendation of the directors to declare a dividend for the half-year ending 30th June last, at the rate of six per cent. per annum.

Jonathan Mellor, Esq., of Rochdale, chairman of the board of directors, presided.

The Secretary read the following circular, a copy of which had been sent to every shareholder:—

"Universal Private Telegraph Company,
4, Adelaide-street, West Strand, W.C.,
London, August, 18th, 1864.

"Sir,—Although the special Act of this company only requires that one general meeting of shareholders shall be held annually, the directors, after a careful review of the progress of the works and the profits already realised, have issued summonses for an extraordinary general meeting, to be held at this office, at 2 o'clock, p.m., on the 24th inst., for the purpose of deciding whether an interim dividend for the half-year to 30th June, at the rate of six per cent. per annum, shall be declared.

"I am happy to inform you that after payment of this dividend there will remain £2,373. 16*s*. 5*d*. to the credit of revenue, being £320. 17*s*. 4*d*. more than the balance carried forward in March last, and there appears to be every prospect of maintaining this dividend for the future.

"The question of the honorarium to be awarded to the directors, which would have been introduced at the last general meeting but for a casual oversight, will be brought forward upon this occasion. This, I need scarcely say, is entirely a shareholders' question. Yours faithfully,

"Jonathan Mellor, Chairman."

The Chairman said the directors had thought it their duty to call the shareholders together for the purpose of recommending them to declare an interim dividend for the half-year, at the rate of six per cent. per annum. They could recommend this with confidence, which would show the shareholders that considerable attention had been bestowed upon the management of their affairs, the results of which gave promise of an increased dividend in the future. They would see from the accounts which they had received that the directors had not touched the balance, which was carried over from the last meeting, and the proprietors would receive the dividend proposed to be declared leaving that balance intact. There was another question to be brought before them that day, and that was the subject of a honorarium to the directors, which, but for a casual oversight, would have been brought forward at the last meeting. That, of course, was a question for the consideration of the shareholders. He moved that a dividend be declared for the half-year ending 30th June last, at the rate of five per cent. per annum.

Mr. Gaussen, deputy-chairman, seconded the motion, which was carried unanimously.

Mr. Mackenzie said the shareholders had had the benefit of the services

of the directors some years for nothing, and he thought it was high time they made them some acknowledgment for those services, which had been of a most valuable character. He did not know exactly what to propose or what the directors would be satisfied with, but he thought that they ought to be paid from the commencement.

The Chairman said the directors did not wish the motion to have a retrospective action, but simply to take effect from the present year.

Mr. Mackenzie said he would rather have a small and efficient board handsomely paid, than a large board badly paid. There was no question that they ought to pay their directors handsomely. He considered that the position of the Company was very much better now than it was two or three years ago, and the benefits conferred upon the public by the company were such that its progress would go on increasing every year. It was like the supply of gas, to talk of cutting it off would not suit the public; there was only a sort of Hobson's choice about it, and they must go on with it, as they could not do without it. A similar result would follow if it was proposed that the Private Telegraph Company should shut up shop. The public could not dispense with its services; and every one they supplied with the telegraph would recommend his friends to be similarly supplied. He was satisfied that though their dividend was now six per cent. per annum, it would, in the course of a few years, be greatly increased. As to the honorarium to the directors, he thought, considering they had the services of gentlemen from Glasgow, Manchester, and London, in the management of the company, that the sum he was about to propose was not too large. He had great pleasure in proposing that a sum at the rate of £600 per annum be awarded to the directors for their services.

Mr. Reid had great pleasure in seconding the motion.

A Shareholder made some observations, but they were wholly inaudible at the inconvenient spot set apart for the representatives of the press.

Another Shareholder thought that the expenses of directors living out of London, consequent upon their attending board meetings, should be defrayed out of the funds of the company, and suggested that such an addition be made to the motion.

The mover and seconder having acquiesced, the motion was with the addition carried unanimously.

The Chairman, in acknowledging the vote, thanked the shareholders for the confidence they reposed in the directors, which would be a stimulant to greater exertions on their part. He would rather have their actions speak for them than formal addresses delivered at meetings of shareholders.

Mr. Mackenzie moved a vote of thanks to the chairman, deputy-chairman, and directors, for their assiduity and great attention to the interests of the shareholders. He spoke from experience when he said that the directors, individually and collectively, gave their personal attention to the business of the company, and that was the secret of their success.

The motion was seconded, and carried unanimously.

The Chairman, in returning thanks, said every diligence and attention should be given by the directors to the interests of the company, in order that it might be made that satisfactory concern which he thought it was capable of being. The directors were assisted by zealous officers who did all they could to promote the interests of the company, and to make it what the directors wished it to be—profitable to the shareholders.

The meeting then separated.

CORRESPONDENCE.

THE SUBMERSION OF DEEP-SEA TELEGRAPH CABLES.

To the Editor of the Telegraphic Journal.

Sir,—I beg herewith to forward to you, for Mr. Martin's perusal, the pamphlet descriptive of the cylinder which I have proposed for and still believe to be the best means of laying submarine cables. Your correspondent is perfectly correct as to Mr. Lavater's prior specification of a floating cylinder, but without any means of preventing the cable, once partially unrolled, from running itself off entirely in deep water, or of regulating the delivery of cable in proportion to the rate of the ship. This is accomplished by the putting of paddle-wheels on the ends of the cylinder in my system.

But besides this, I must also state that I independently invented, and described in a letter to Sir Baldwin Walker in 1857, the whole system of floating cylinder with all attachments. I was then serving in Brazil, and had never heard anything of Mr. Lavater, whose acquaintance I first made soon after my arrival in England in 1858, when, on seeking provisional protection, I was informed of the existence of Mr. Lavater's invention. I at once communicated with him, and I have his letters still. We agreed to take out the patent together; but circumstances occurred which induced him to give up any further share in the enterprise. Since then I have consistently advocated the system as the cheapest and safest, as well as the most seamanlike, method of laying cables in the state in which the makers left them; and Mr. Lavater before we parted expressed himself perfectly satisfied that the cylinder alone would have had little value without the modifications which only a seaman could be expected to foresee as necessary.

I hope that the contemplated laying of an Atlantic cable by means of the Great Eastern may prove a success, for I am confident that the cheapest and best means of laying will eventually be brought into use; and I do not think that we shall ever build as many Great Easterns as I trust we shall lay deep-sea cables. A failure would be the worst possible occurrence for all parties, as not only would shareholders lose their money, but telegraphic progress would receive a "heavy blow and great discouragement."

But I cannot say I am sanguine that this success is certain, for I see that the time occupied in laying must be doubled, and therefore the chances of a fatal gale of wind must be increased; that the cable is proportionately lighter than its predecessor, and therefore exposes a greater area to cross currents on the surface; and that, though the Great Eastern may pitch less, she rolls worse, and will "*scend*" or travel forward with the wave more in proportion as she is longer than former vessels. These are added difficulties where already there were enough; and if we join to this that in spite of all the lessons already received, a spiral system of outer wires is still adhered to, bedded in a material even softer than gutta-percha, as hemp, a system which adds weight without contributing one iota to strength quoad the conductor, I fear much that we have no right to look for success or to hope that we shall avoid failure.

Even now this element of strength which the "happy accident" of the Persian Gulf cable should teach us is wholly wanting in spiral wire covered cables, might be supplied to the Atlantic by the use of straight steel wires embedded in macintoshes—not Bright and Clark's—compound macintoshes having the great advantage of being flexible and easily put on cold, while Clark's is brittle, and must be put on hot, or at least warm.

I am quite sure that no precaution will prevent (with the asphalte coating) rapid decay of the iron sheathing at hundreds of points where it will be rubbed or cracked off during the laying; and if, as some say, it is no matter how soon the outer wire decays after the cable is down, what, in the name of common sense, is the use of the iron sheathing at all? As for protection from mechanical violence during the multifarious coilings back and forth, the best remedy for that seems to be an inquiry whether such treatment is necessary or no, and I think there are now very few believers in the foolish idea that the wires form an arch, and therefore cannot extend, so that I do not anticipate finding any advocate for their use in giving strength as far as preventing the rupture of the conductor is concerned. I propose at the coming meeting of the British Association to go into the question of submarine telegraphy, and I hope that scientific inquiry may then be able to establish facts of which I have myself long been convinced, namely, that cables can be made at half the price now considered necessary, with a far better insulator than either gutta-percha or india-rubber, and one which at the same time has much less inductive capacity; also that cables can be laid without difficulty if seamen be allowed to decide the route and the means to be adopted, and be not, as heretofore, only grudgingly called in, when the wrong way has been tried and failed, to have their opinions stolen and misused by those who would unjustly reap the rich harvest of rewards, a harvest of which only professional skill can either sow the seed or deserve the return.—I remain, yours truly,

London, August 23rd, 1864. J. H. Selwyn, Capt. R.N.

[We have forwarded the pamphlet to our correspondent. Captain Selwyn's explanation is most satisfactory.—Ed. *T. J.*]

INDIA-RUBBER CABLES.

To the Editor of the Telegraphic Journal.

Sir,—Despite all that Mr. Henley may say, gutta-percha insulation for long deep-sea cables is a prodigious failure, and to go on using it is only to increase the magnitude of the blunder. Now, no one regrets this more than the advocates of india-rubber; and I again assert that this has had more to do with keeping rubber out of the field than any other cause. Where the "strangeness" of the assertion can be I am at a loss to comprehend. Shall I insult the discernment of your readers by explaining how? Suppose the Atlantic cable, the Red Sea cable, and other important long lines that have failed, had been successful, should we not have had some 40,000 or 50,000 miles of long deep-sea telegraphs ere this? And would it not have taxed the combined efforts of both gutta-percha and india-rubber men to supply the demand? Then there would have been a "fair field and no favour;" both materials would have been tried on the same vast scale, and men like Mr. Henley would then have been able to have written about rubber with the same glib familiarity as they do about percha: whereas, it were wise now if they would refrain from condemning a material they know nothing about. But, alas! it is not so. We have no long cable; all have come to grief; and the ones promised are looked upon as hazardous experiments, the success of which will disappoint the world more than their failure. For the sake of the tax-paying public, the Atlantic telegraph shareholders, and the firms who have embarked large capital in both gutta-percha and india-rubber, I do fervently hope that we may be most agreeably disappointed in this way, and that the former material may prove to us indubitably that it is not a prodigious failure. At present, however, that is the verdict, nor can Mr. Henley or any one else show that it is not so.

Referring to his first letter, Mr. Henley says, "My only object was to vindicate myself from misstatements," &c. What a pity he did not confine himself to this. Certainly the comparative merits of the two insulators is a subject not necessarily wrapped up in it.

Mr. Henley is a man who has risen from the ranks: so much the more to his honour. He is, I believe, generally esteemed as second to none in his

trade or profession, or whatever it may be termed, and, having been a working man, he is, of course, a practical man; and certainly in telegraph operations we could do very well with a few more such men; but then his letters prove him to be characterized by more than all the dogmatism, self-sufficiency, and exclusiveness of his class—a class who peculiarly abound in bounce, by which the detraction of others serves to set off themselves. There is more "buncombe" in these two letters than I have seen in any other two out of the domains of President Lincoln. Of course he can make 20 miles of cable a day—why not? or 200 perhaps? It is immaterial which while you are about it; the generality of people care very little about these things; but it is hardly seemly to say, "Oh, I don't believe so-and-so have done such a thing, or can do it," and a great deal of the same sort, which could have nothing to do with the subject, and, withal, is far from being gentlemanly. He should go back a few years, and compare notes; but this is a disagreeable strain, and I can only regret your correspondent should have led me into it.

Mr. Henley thinks well to contradict me in a few minor matters: it is perfectly immaterial. He is referring to the present. I was speaking in the past tense. I am truly pleased his facilities for cable manufacture are so effective. I like to hear of a man getting on; but it betrays a pettiness of disposition unbecoming any man to be so complacently self-satisfied of his own position while disingenuously trying to injure another's.

Your correspondent says, "Gutta-percha needs no puffing." Well, that's a good joke at any rate. Mr. Henley himself has puffed it enough to last a twelvemonth; in fact, according to another correspondent, he has puffed it up to such an extent that the other has vanished completely from the field; "its days are over," so let us sing its requiem.

Gutta-percha never fails, certainly not. But what becomes of it "when suspended in air?" It never "shrivels up," I suppose, nor "peels off," nor goes to dust? And of course it never goes bad out of sight. We are all good people when no one sees us, or can know to the contrary; but I could show Mr. Henley a gutta-percha wire, the insulation of which was no better than so much rotten cheese after four years' submersion; but this would be superfluous; you know the distich, and that will save me the trouble of quoting it.

"Hit a man when he's down," that is the way of the world, and therefore it is sound philosophy. It is assumed that india-rubber is come to grief, and so Mr. Henley hammers away like a good old Anglo-Saxon. Well, well, we know who pulls the strings; but wait a bit; it is quite premature to give the finishing stroke yet. It is a dummy you are belabouring all the while, I fear. Candidly, I think you'll find the real antagonist worthy of you. It will come forth as a giant refreshed by-and-bye. But what has led to all this hubbub of valiant knights coming forth to do battle? Verily, a ruse or a scarecrow. More will be known shortly. At the present a report is set afloat. What is it worth? What is the ostensible motive for putting it forth? Simply as a sort of stalking-horse to divert attention from something far more serious: what that is I need not say. It causes nervousness in certain quarters lest that should certainly result which has been prognosticated over and over again, and which some persons in high quarters have been expecting all along; and so this allegation will serve as a set-off.

A word or two with "R. Watson," the little echo of Mr. H. You are mistaken, sir, if you imagine I "plead for the manufacturer," or any one else. I think the manufacturers were very foolish for having anything to do with the making of the cable if they were not allowed to make it on their own patent; and I said as much before. I presume these gentlemen are competent to plead for themselves if they find it necessary; they are acting wisely, however, in treating the absurd nonsense that has been written with silent contempt.

You speak of a "defunct india-rubber cable in the Persian Gulf." Upon my word, sir, you must be a well-informed individual—far more so than even Colonel Stewart.

Can I "bring forward a single instance in which india-rubber has succeeded?" Why, my verdant friend, india-rubber never fails, "if properly treated." (Mr. Henley uses the qualifying "if" with the immaculate, and surely I may be allowed). The mischief of it is it *never has been properly treated* in the few instances in which it has been tried for submarine cables: and I deny in toto that it ever turns to treacle in sea or in earth when manipulated in a certain way, and I could produce a dozen instances in proof of it.

I am obliged for Mr. Henley's advice. In reply he will give me leave to say that I opine it would be more to his and others' credit if they were to give this matter a fair and dispassionate consideration, instead of "bolstering up" a monopoly which weighs like an incubus on the neck of a young science, and in which our bungling and blundering has made us the laughing-stock of the world. But what does this matter so long as monopoly and its parasites can fatten upon the spoils of the credulous? If we go on as we have commenced, submarine telegraphy will engulph more hard cash than was lost in the South Sea bubble, and hitherto it has been about as safe a speculation; and it certainly promises no great things for the future, when those who are striving to make it a safe one are hooted out of the field.

Because of the alleged failure, or partial failure, of twenty miles of india-rubber cable, there is a hullabaloo set up, as though this metropolis were on fire; but there is a comparatively dead silence when thousands upon thousands of miles of gutta-percha cable give up the ghost and become useless, and none but the fates, and perhaps one or two officials, have any conception of the huge heaps of useless wire of the same sort that year by year accumulate in the storeyards of the various telegraph companies. Altogether, this fierce onslaught of sleek monopoly is as unseemly as it is futile, and, as it will ultimately prove, uncalled-for.

With significant inconsistency Mr. Henley shirks the main thing. I may get the percentage of a workable cable myself. It would damage his cause and the cause of those he serves to do so. Probably I shall take an early opportunity of doing so, and then, sir, your readers may judge for themselves of the value of Mr. Henley's eulogiums. Mr. H. may have the last word if he choose. I have nothing further to say to him. Beppo.

THE TELEGRAPH CLERKS' FUND.

To the Editor of the Telegraphic Journal.

Sir,—I read with great pleasure the account of the soirée and conversazione given by the above excellent institution on the 8th inst. What pleased me most was the novelty of a telegraph company Director being present. I agree with you that great credit is due to Mr. Sheward for attending a meeting of the kind, the object being so praiseworthy. It is painful to think that telegraph directors, and those put in high authority under them, do not evince the least interest for the welfare of their employés generally; in fact, I was informed the other day that in one or two large establishments the "servants did not know their masters even by sight." I hail with satisfaction the efforts of the employés to foster that kindly feeling among themselves which certainly does not exist between the directors of their respective companies.—Yours obediently, A Shareholder.

TELEGRAPHIC NEWS.

Time Gun.—At the last sitting of the River Tyne Commissioners the Dredging and River Works Committee reported that a letter had been received from the solicitor of the Electric Telegraph Company, on the subject of the agreement between the company and the commissioners for the transmission of the electric current from Greenwich to fire the time guns at Newcastle and Shields.

Marine Signals for all Nations.—The French Minister of Marine has made a report to the Emperor in relation to the establishment of a universal code of maritime signals, which will offer to all nations a uniform means of communicating at sea, and with lighthouses on the sea-coast. The Emperor, upon receiving the report, issued a decree, in which he states the commercial code of signals for all nations—such as has been adopted by the Anglo-French Commission—shall be the only one employed for the interchange of communication by French vessels, either among themselves and with semaphores on shore, or with the vessels of other nations. This is very important to mariners, and the vessels of the United States should immediately procure the flags and books.

The Atlantic Cable.—We see it stated that Mr. Cyrus W. Field has sailed in her Britannic Majesty's steamer Margaretta Stephenson for Trinity Bay, with the purpose of selecting a place for the landing of the Atlantic telegraph cable. This would prove that this long-promised and eagerly-expected communication between the Old World and the New may be realized ere long. It is stated in the London journals that the new cable is of so superior a make that it may be confidently expected it will not break. This cable, if successfully laid, will revolutionise many things. It will undoubtedly tend to promote good-will between us and the European communities, and will prevent those misrepresentations which so frequently lead to national difficultes. A French company, or rather a project of a company, for laying an ocean cable between France and this country has been started in Paris; but unless the line from England be successful this will never be undertaken. The purpose of the French company is to form an opposition or competition, in case it is proved that a line may be worked. Messrs. Rowett and Troltes, the parties who represent the French company, have been ventilating the thing for years; but no attention was paid to them by the French Government until it became apparent that one more trial would be made by the original Atlantic Telegraph Company; then the Emperor Napoleon ordered his Minister of the Interior to grant to Messrs. Rowett and Troltes a concession for connecting the islands of St. Pierre and Miguelon with France by an ocean cable. The interest of the world at large will, of course, be served by having two cables, and in case of the success of the first the second will unquestionably be laid.

The Overland Telegraph to Russia.—Amid the bustle of war a work of peace and civilization has been steadily growing. The telegraphic project to unite the United States and Russia has entered into the stage of real work; the last impediments have been overcome, and now Mr. Collins, conjointly with the Western Union Telegraph Company, has already begun the work. Four ships have been chartered and freighted with the telegraphic wire, implements, provisions, tents, &c., and will soon start for San Francisco, sailing round Cape Horn. This fall the fleet will reach San Francisco. The Government of the United States has detailed a man-of-war for the purpose of helping the company. Four exploring parties will be left respectively at New Westminster, Fraser river; Point Desolation, on the line between British and Russian America; Sithka, the capital of

Russian America; and at Cook's Inlet. These parties are to explore the coast; if possible, obtain all the timber wanted; and prepare the ground for next spring's work. Mr. Collins hopes that in two years from autumn the two continents will be united. The capital of ten millions of dollars for this transcontinental line has been subscribed in the United States; and the Russian Government builds on its own account the line from Petersburg to Nikolaef, on the Amoor. The line has already reached Chita, a town situated at the confluence of the Shilka and Erlon, the beginning of the Amoor.—*New York World.*

Anglo-Indian Telegraph.—The insurrection of the Montefic Arabs is now entirely quelled, and the state of the disturbed district between Diwanyeh and Korneh is now such that the telegraphic works can be resumed, but it will not be possible to make much progress until the autumn, as the men can do very little work during the present hot and unhealthy season. Colonel Goldsmidt arrived at Mosul (the site of the ancient city of Nineveh) early last month, on his way to Constantinople, to report on the condition of the line through Asia Minor. He will then meet Colonel Stewart, C.B., who left Bombay by the mail of the 24th June. It is earnestly to be hoped that strenuous exertions will be made by the Government to provide a proper service of English Clerks at the chief stations between Scutari and Fao, without which it is utterly impossible that the enormous commercial traffic which may be looked for directly the Anglo-Indian line is opened can be efficiently performed. The technical character of the messages between merchants in England and India, the quotation of prices of various kinds of stock and goods, the names of vessels, and many other details which will naturally occur to any one accustomed to the daily routine of a telegraphic instrument room, will otherwise be so mangled in transmission as to render the line more an agent of confusion than of utility, and the result of a bad beginning will retard the advance of the traffic afterwards more than the Turkish Government (who are so largely interested in obtaining good returns) can probably receive. By far the greater part of the messages will be in the English language; and it is absurd to suppose that any Turkish official, however much he may have studied it, can master the names and expressions of mercantile dealings sufficiently to cope with the business in a satisfactory manner. The Persian line between Teheran, Ispahan, Shiraz, and Bushire, is proceeding rapidly, and will most likely be (in connection with the Russian line *viâ* Tiflis and Tabriz) the first by which the Persian Gulf cable is worked through to India.—*Malta Observer.*

Singular Accident from Lightning.—The following interesting account of a meteorological accident at Dachute has been communicated to us (*Montreal Herald*) by a friend, to whom the letter containing it was addressed:—"We met with rather a serious accident from lightning on Monday last; but we have reason to thank God we escaped so comparatively unscathed. Between two and three o'clock our house was struck. The crash was terrific. The electric current penetrated the building, struck the bell-wire, and ran along it in both directions—the one current ran along the wire into the interior of the building, until it passed into the cellar where it escaped into the ground, and ignited my surgery floor in its course; the other current followed the other extremity of the wire, and passed through the bell-pull and struck one of my children, a little boy of nearly four years of age. The fluid ran down the left side of his head and face, burning the hair and discolouring the skin, and along the chest and inside of the arm, and escaped into the ground tearing up the floor in its passage. After a short time the whole of the left side of the chest and inner side of the arm became covered with livid veneations. The child appeared to be dying for some time, but gradually recovered. The cold effusion appeared to be beneficial in restoring animation. He lay unconscious for a considerable length of time, and after recovering he vomited at intervals for nearly twenty-four hours. He appears to be out of danger now, but suffers severely from the extensive blistered surface. The building is perforated in several places about the size of a musket-ball, and blackened as if charred with gunpowder; but otherwise is not much injured. The bell-wire was fused, and dropped in globules on the floor where the wire passed into the cellar and the floor ignited, but the fire was easily extinguished. The house was provided with lightning-rods, one at each end of the building. The rod converged on the roof like the letter S, and from thence was carried down the back of the house into the earth to the depth of eight or ten feet. The rods were carefully insulated by means of glass, and all electric connection with the building cut off. The conductors were the grooved curved-iron rods in general use with copper points; the electric flash appears to have struck the rod on the west-end of the building (the point is fused and bent), and, being overcharged, a lateral discharge took place to the gutter which was lined or covered with tin. The fluid appears to have run along the gutter to the other end of the building as far as the tin extended, and then forced itself through the back walls into the house. I suppose had the rod been larger, or had the gutter been connected with the rod and the earth, the accident might have been averted. It appears to me that the rods in general are too small to carry off an extensive flash with that ease which is necessary to prevent a lateral discharge. What is your view of the matter?"

Naval and Military Telegraphy.—An exposition of the system of telegraphy for the joint use of the army and navy in combined military and naval operations, which has been brought to its present state of perfection by a series of experiments extending over some months by Captain Frank Bolton, of the 12th Regiment, and Commander Colomb, of her Majesty's navy, took place on Friday, the 19th inst., under the inspection of the Lords of the Admiralty, and was attended with the most perfect success. Their lordships had left Portsmouth in the afternoon in their yacht Enchantress, and anchored for the night in Cowes Roads, the Pigmy paddlewheel steamer, Master Commander Vine (fitted with sets of signalling apparatus), following from Portsmouth, and anchoring near the Admiralty yacht. The Pigmy thus became one point of communication, which may be termed the central, with the Lords of the Admiralty on board to watch and direct the proceedings. The Pigmy carries one of Captain Bolton's army field lime-lights, and is also fitted with the magneto-electric light of precisely the same nature as the one that throws its powerful rays nightly across the Channel from Dungeness Lighthouse. Commander Colomb was on board the Pigmy, and conducted the signalling, under the direction of the Duke of Somerset and his colleagues. The three outlying signal points from the Pigmy were —the semaphore tower, in Portsmouth Dockyard; Ash-down, in nearly the centre of the Isle of Wight; and St. Catherine's-hill, the high land near Black Gang Chine, at the southern extremity of the island. At the semaphore tower was one of Captain Bolton's army field lime-lights only, in charge of Captain Bolton and a corporal of Engineers. On Ash-down was a similar instrument in charge of a couple of Engineers or Sappers, and on St. Catherine's was a similar instrument, with also a magneto-electric apparatus, in charge of four Engineers. The time appointed for the signalling to commence was nine p.m., and the initiative was to be taken on board the Pigmy. It was considerably past that time, however, before the Pigmy made any sign to those in the semaphore tower at Portsmouth, and it was evident that the Lords of the Admiralty were either directing messages to St. Catherine's-hill in the first instance, or there must be an intervening fog between the signalling points undiscoverable from the semaphore at Portsmouth. The former eventually proved to be the case. Captain Bolton, anxious to discover the real cause, flashed his light in the direction of Ash-down, and the "call" being at once answered, Captain Bolton flashed the question as fast as the words could have been slowly spelt, "Have you any fog there, or is there any visible round St. Catherine's?" The answer, flashed as quickly back, was, "Nothing that we can see." The call signal from Portsmouth to Ash-down was made and answered, and these messages sent and received in two minutes thirty seconds. St. Catherine's station was next flashed into position out in the darkness, and told to keep a "sharp look-out." At ten p.m. the magneto-electric light on St. Catherine's-hill burst into view over Ryde, with all the brilliant intensity of a summer noon-day's blue sun, and "winked" out its message, "Cowes has seen us; good night." Portsmouth, however, was anxious to know what Cowes had said, and Captain Bolton, by a couple of flashes from his diminutive apparatus, checked his powerful friend and agent on St. Catherine's-hill, and put the necessary question. Again the wonderful light winked through the darkness, and, commencing its answer, said, "They asked us if we could." At this point Captain Bolton had to signal "Wait," for Commander Colomb on board the Pigmy at Cowes was calling attention with his magneto-electric light, and, on being answered, sent the following message (having no official meaning) to Vice-Admiral Sir Michael Seymour, at his residence in the dockyard, from the Lords of the Admiralty, who were on board the Pigmy, then from on board their yacht Enchantress:—"Semaphore tower, inquire of Sir Michael Seymour if the Channel fleet have coaled; ask also which boat won the race." This message was sent from the semaphore tower to the residence of Sir Michael Seymour, and an answer was sent across by the lime-light that—"The Channel fleet have not all coaled yet. Admiral Elliot's boat won the race." Their lordships now quitted the Pigmy for their own yacht, quite satisfied with the experiments, and a parting "Great success" again winked by the magneto-electric of the Pigmy to the lime-light on the Portsmouth semaphore tower closed the proceedings, and the Pigmy immediately weighed her anchor and returned to Portsmouth. It will be understood at once from the hour at which the signalling took place that only the night system of Captain Bolton and Commander Colomb was put under trial by the Lords of the Admiralty, and this course was taken for the reason that if difficulty in transmission existed in one part of the system over the other, it must be with the night rather than the day system, from the fact that fogs—that great enemy to all sight signals—are in greater force about the high lands of the Isle of Wight by night than by day. The magneto-electric light and the lime-light may be shortly described as follows:—In the magneto-electric the power that produces the light is resident in 120 permanent magnets, of about 50 lbs. each, ranged on the periphery of two large wheels, the latter driven by steam power, which causes 160 soft-iron cores surrounded by coils of wire to rotate past the magnets. The small streams of electricity thus generated are collected together into one stream, and by a special piece of apparatus, termed a commutator, the alternate positive and negative currents are all brought into one direction, and conveyed by a wire to the illuminating apparatus and "lamp," or "regulator." The lime-light is obtained from the ignition of a piece of lime, the shape and thickness of a small cedar pencil, by submitting it to the intense heat evolved by the compound flame of hydrogen and oxygen gases in the proportion in which they form water. The lime does not burn, but simply becomes brilliantly illuminated without undergoing any chemical change. This light is stated to be the most intense and pure known, with the exception of the electric light, over which, however, it possesses the great advantages of being steady and continuous, and its volume capable of being increased at pleasure. The cost of the magneto-electric apparatus is something like £2,000 at present, but it can be produced more cheaply as it is brought into use, and its cost of working is said to be comparatively trifling after it has been established. The cost of Captain Bolton's lime-light field

apparatus, complete for field service, and such as is now supplied by the War Department to our Royal Engineers, is about £35. The lime-light will receive and transmit signals with certainty to a distance of twenty-three miles. The range of the magneto-electric is greater. The lime-light is now supplied to every ship in the Channel fleet for night signalling, having superseded all other signal lights, and especially those with coloured glasses. The army and navy have thus already adopted the light officially to a certain extent, and it is with the object of its complete adoption throughout both services that Commander Colomb and Captain Bolton have now for some months past been employed upon these experiments to perfect a set of signals which may be introduced as the signal code for the conjoint use of the army and navy, and upon this part of their duties the commission to be named by the War Department and the Admiralty will immediately be formed and make a report. The entire system of transmitting the signals by day and by night is available under all circumstances, and is expressed by jets of steam, revolving shutters, a collapsing cone or disc by day; by one bright light by night, and by a fog-horn or steam-whistle in a fog. With these means the following results have been already obtained:—1. Perfect communication by day has been established between St. Catherine's Down, Isle of Wight, and her Majesty's steamer Pigmy, with the shutters and jets of steam, the Pigmy being 16 miles off at sea, at the rate of two signals in three minutes, including the transmission of the signals from St. Catherine's to the semaphore tower at Portsmouth, an additional 16 miles. 2. Perfect communication by night between the same points, at a seaward distance of 30 miles by the electric light, and a seaward distance of 22 miles with the lime-light, at the average rate of one signal per minute, the weather being ordinarily clear. 3. Fog signals by sound with common ships' fog-horns, at a distance of three to four miles, at the same rate of speed. Messages of 12 signals have been sent from St. Catherine's Down to the Pigmy, and *vice versâ*, at a distance of 17 miles seaward, in a gale of wind, and transmitted to Portsmouth in eight minutes, including the repetition at St. Catherine's. On the night of the 18th instant 200 signals were sent between Portsmouth and St. Catherine's Down in one hour. The new code may be said to be based upon the Morse telegraph, the short and long dashes in the printing of which are represented by Captain Bolton and Commander Colomb by the time the jets of steam, cone, or disc, or shutters, are exhibited by day; the time the light is flashed in by night, and the duration of the sound emitted by the steam-whistle or fog-horn in a fog. For exhibiting the light or cone on board ship, Commander Colomb makes the duration of the signal dependent upon a mechanical arrangement of his own invention, which leaves nothing to the judgment alone of the signalman, and makes use only of numerals, which are thus applicable to the present naval signal-books. In the telegraphic corps of the Royal Engineers, Captain Bolton's arrangements for fixed military stations, such as the semaphore tower at Portsmouth, as the head-quarters for telegraphic communication with all the surrounding fortifications are independent of any signal-book, the operator flashing each letter of a word from the point of his lime-light as he sends his message. It is evident, however, that this independent method would not answer at sea, where the flagship must keep repeating a message until answered by each ship in the squadron, and for this latter necessity Commander Colomb's mechanical regulator expressly provides, making and repeating the signal independent of any skill on the part of the seaman signalman.

MISCELLANEA.

The Reward of Genius.—While the exploits of the conqueror and the intrigues of the demagogue are faithfully preserved through a succession of ages, the persevering and unobtrusive efforts of genius, developing the best blessings of the Deity to man, are often consigned to oblivion.

The Preservation of Telegraph Poles.—The following composition is recommended to protect the bottoms of posts set in the earth:—Forty parts of chalk are added to fifty parts of resin, and four parts of linseed oil, melted together in an iron pot. One part of native oxide of copper is then added, and one part of sulphuric acid is cautiously stirred in. The mixture is applied hot with a strong brush, and forms, when dry, a mixture as hard as stone.—*Neues Jahrb. für Phann.*

Reporting by Machinery.—An instrument has been invented by Mons. Bryois for the purpose of taking short-hand notes with more than usual rapidity. It consists of a series of levers worked by keys like a pianoforte, and acting on types which impress themselves on a strip of paper that is gradually unrolled. It is said that an ordinary reporter, with one finger only, can work as quickly as the best short-hand writer, and that by using both hands the rapidity is immensely increased.

TELEGRAPHIC POESY.

O! lazy clerk, that sittest in the dark,
Awake and send a message, like a dove
With olive-branch, unto a little ark!
Go, take this merry message to my love.

O! lazy clerk awake the sleeping wires,
And let my thought flash swifter than the light;
Go, tell my love that when the sunset fires,
I shall be with her ushering the night.

—*Illustrated Times.*

Steadfastness.—He who remains in the mill, grinds; not he who goes and comes.

Relative Effect of Different Points upon Lightning Rods.—By means of an electric machine I charged a large metallic plate, representing a cloud, until a very sensitive electrometer marked 10°. I then gradually approached to the plate, first a rod rounded at its extremity, such as M. Despretz has proposed as the terminal of a lightning rod, afterwards an ordinary lightning rod point, and finally a very sharp point. These experiments gave me, as a mean, the following results:—1. The round-pointed rod remained without neutralising effect until it was struck, at a distance which I shall assume as the units. 2. The neutralising action of the common point did not begin until the distance was less than twelve units. 3. At the distance of twelve units, at which the common point had no neutralising action, the sharp point discharged the plate instantaneously. 4. The neutralising action of the sharp point began to show itself when the distance was less than 170 units. The neutralising action of the fine point, therefore, extended nearly 170 times further than the striking distance, or thirteen times further than the action of the common point.—*Comptes Rendus.*

PRICES CURRENT OF INSULATING MATERIAL.

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third Negro-head	1/2½	„
Java and Penang	1/3 to 1/5	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	68 to 65 x. d.	—
Stock	Electric Telegraph . . .	100	102 to 106 x. d.	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1¼ to ¾	—
10	Mediterranean Extension Tel. .	all	3 to 3⅛ x. d.	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to ½ pm.	—

TO CORRESPONDENTS.

K. R.—The list of telegraph companies promised in our last number is unavoidably postponed until next week.

L.R.—You must apply in the first instance to the lady-superintendent, who will examine you as to your qualification, &c.; the influence of a director would greatly assist you in the matter.

A Subscriber.—We believe that Mr. Haworth's invention is not in practical operation.

J. Mallet.—Apply to the secretary at the chief office, Gresham House. The company deserve well, as the initiators of cheap telegraphy.

A Reader.—Your communication respecting the telegraph clerks' fund will appear in our next number.

Anxious.—We have instituted strict enquiries, and find that there is no foundation for the report which appeared in several of the daily papers some two or three weeks ago, of the communication through the Persian Gulf cable having been interrupted; the only interruption being on the land lines, between Bussorah and Bagdad.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

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THE TELEGRAPHIC JOURNAL.

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THE EGHAM ACCIDENT.

HAVING satisfactorily shown, in a recent number, that this serious accident would indubitably have been avoided if the line had been worked upon the "block" principle, we think it would only be our duty to the Railway Company and our readers to give them our opinion upon the best system which they could adopt in carrying out this plan. The "block" system is the plan by which trains are maintained apart by a certain and invariable interval of space, instead of an uncertain and variable interval of time. Most railways have hitherto been worked on the time system. Experience and, notably, the Egham accident has proved this to be unsafe. Where fast express and slow goods trains are travelling over the same line, now through a thick fog, now up a wet incline, it is impossible to maintain that rigid interval of time which is essential to prevent collision. When, however, two trains, however rapidly or slowly they may be running, are invariably kept apart by an interval of two, three, or four miles, such accidents are impossible. This is effected by the "block" system. Railway companies are very chary of introducing this system, upon the plea that it produces delay, but practice shows that delays are not so excessive under its *régime* as under that of the old plan. Instead of keeping the danger signal on for five minutes, and the caution for five minutes more after the passage of each train, the signal can be lowered to "all right" immediately the train is signalled out of its length, and trains can run with perfect safety at intervals of two minutes, or even less. Every manager who has ever introduced the system upon his own line is found to advocate it strenuously, while its opponents are those who have never used it at all. It has had to run the same gauntlet as every other practical reform, and beat down all opposition by sheer force of truth and reasoning.

The chief object to be attained is that of making the next station practically a distant signal, to protect the line from any following train. This could be easily carried out, were it mechanically possible to work a signal two miles off, and blow a whistle that could be heard that distance; but as this is impossible, electricity has been made use of to supply the want. The moment a train enters a section of line its approach is announced to the station towards which it is going by the sounding of a bell or gong, and the line behind it is protected from any following train by a danger-signal being raised and maintained in that position until the train has passed clear of that section. This, it will be perceived, is just what is done by a distant signal within sight: the train approaches, the signal is put up, and it is not lowered until the train is clear. This is a very simple operation to perform, when the mechanical contrivances for effecting it are within sight and within reach. Great precautions are, however, required when that subtle force, electricity, is used. There are many ways employed to give this danger-signal; on some lines a small needle is deflected, and points to the words, "train on line;" on other lines the words are brought up to a small opening, and stare the signalman in the face. The South-Western Company makes use of the same signal to denote "danger" and "all right" in their telegraph instruments, as is used on the line itself. Thus where semaphores are employed on the line, a miniature semaphore is worked by electricity in the signalman's box; where discs are used, miniature discs are employed. A uniform system of signalling is thus adopted throughout the whole service.

To Mr. Cooke, the original introducer of the electric telegraph, must be accorded the merit of having first shown how a line might safely and economically be worked by the aid of the electric telegraph. He conceived a line of railway divided into sections, each of which should be governed by its own telegraph, and into which no second train should be allowed to enter until the first train had been signalled clear of it. Thus while a train was running from one station to another, the instruments at each station should show upon their faces that a train was running between them. The signal upon the instrument at the station from which the train started would be taken as a danger signal, until the train arrived at the second station, when it would be taken off and a second train allowed to proceed. The outdoor signals would follow the telegraph signals, and thus be practically worked by them. The telegraph signals thus become, to all intents and purposes, distant signals worked by electricity. The actual telegraph signal itself is not seen by the driver, but the signalman who has charge of the outdoor signals receives his instructions from the telegraph instrument, and the signals the driver sees are practically those of the telegraph. Thus distant signals can be fixed two or three miles away from a station, and in place of protecting a length of line varying from 500 yards to 600 yards from following trains, as is done at present by ordinary distant or auxiliary signals, that protection can be extended for miles, in fact to the next station. The question therefore arises, what is the best kind of system to use to convey clearly and unmistakeably, from one station to another, this *danger signal?* Many railway companies employ the ordinary instrument which is so extensively employed for ordinary telegraphic purposes. This is very simple and effective, but the use of the ordinary needle has many faults. The signals are liable to be reversed by lightning, and "line clear" may sometimes be given when "line blocked" is meant to be shown. The needles may be demagnetized altogether, and no signals whatever pass. The needle is sometimes loaded with cards having the words "train on line," or "line clear" printed upon them, adding immensely to the work to be performed, and increasing the liability to derangement. Perhaps the most perfect example of the needle system is that in use on the North Western line, and it answers admirably all the requirements demanded of it, but still it has all the defects of the needle system, and cannot be said to be that perfect apparatus which the necessities of such an important service require; the signals are under the control and can be actuated by the men at each station. This last defect is remedied in another system which is extensively employed, viz., that of Tyers. This instrument possesses many admirable points, but it has two or three serious defects in its construction and principles which diminish its value. It is worked by one line, and is actuated by momentary currents. The use of one wire may be advantageous in an economical point of view, but for actual efficiency it must be considered detrimental. Two opposite trains cannot be signalled at the same time upon a system based on such a principle, and if any accident arises the whole system is thrown out.

Systems based upon the use of momentary currents, and worked by one wire, are particularly liable to all sorts of accidental derangements. Atmospheric electricity may not only put the instrument *hors du combat*, but may actually produce a false signal. Deflections, those natural currents of the earth

that at times play such havoc with our speaking circuits, derange it completely. False signals may be given by many accidental and artificial causes. The wires might be brought into temporary contact by the wind, or, as they frequently were, by the long levers of the plate-layers, and cases have been known where birds alighting upon the wires have produced similar effects. The wrong button may be pressed, particularly in an instrument like Tyers', where the *same* signal has to be given at one time on one button, and at another time on a different button. The South-Eastern Railway Company have recently established a system based on this principle upon their Charing Cross extension, and we should not be surprised any day to hear of some calamity on that line arising from one of those accidental causes to which such systems are liable. It is so simple to give each line its own independent signal wire, worked by continuous currents, and free from those accidents to which the frail telegraph is peculiarly liable. The Metropolitan and the North Western systems do this, and so does the South Western, which is about to receive such extensive developments, owing to the lamentable experience of Egham.

The requirements of a railway signalling telegraph demand that there shall be a means of communication between two stations—not necessarily a speaking telegraph—which shall give notice of the approach, departure, and arrival of trains; that there shall be one signal to rule and protect the "down" line, and another signal to rule and protect the "up" line; that these three operations shall be conducted separately and distinctly, without interference with each other; that the man at one station shall have the complete control over the signal at the other, and that it shall be impossible for him to interfere or alter the signal at his own station; that every signal shall be acknowledged, and that the acknowledgment shall not only imply the due receipt of the signal sent, but that it has been properly understood and properly acted upon; and that any derangement of the apparatus, or the accidental delivery of a false signal, either by the man himself, or by the mechanical interruptions to which telegraphs are peculiarly liable, shall at once indicate danger, and produce safety. Any system that will undergo this crucial test with impunity, must be considered the *sine qua non* for railway authorities. We have carefully examined every system at present in work, both in this country and on the continent, and there are only two which will in any degree bear a comparison with the requirements we have laid down. They are the needle (Clark's, Spagnoletti, &c.,) and Preece's system, as employed on the London and South Western Railway; but the latter is immeasurably superior to the former, inasmuch as the man at one station has no control over the signals at his own station, and is firmly and fully assured by repeating signals that every signal sent is not only properly received, but duly acted upon. Indeed this system fully meets nearly every requirement we laid down, and is well worthy the deep study of every railway manager.

TELEGRAPHY BY INDUCED ELECTRICITY.

Voltaic batteries, those perpetual nuisances, are in a fair way to be reduced to a minimum. We have just had the pleasure of making some experiments with Mr. Thompson's induction machine. We described this machine some time ago, when it was being exhibited at the Whittington Club-house. It is a self-acting compound induction machine, excited and driven by four, five, or six Daniel's cells. This machine is the only one on the principle that has yet been made; and it was made as an experimental machine, and not for any special purpose. These machines are intended to be applied, not only to ordinary telegraphy, but also to telegraphy by electrolysis, and to the electro-depositing of metals; but, of course, each special purpose will require a special machine. This present machine, though only an experimental one, and not intended specially for any one of these purposes, nevertheless answers exceedingly well for all of them as far as we have yet seen it tested. We have seen it used on a needle instrument, a Morse, and electrolyticly; we have not yet seen it tried at electro-deposit; but we understand that extensive experiments are about to be made in that branch of electro-metallurgy. It has been erroneously supposed that an induction machine, of whatever construction, cannot possibly give electricity in any form but of the highest intensity and of quantity very small. Besides, since Mr. Whitehouse's experiments on the old Atlantic cable, electricians even have spoken of induction machines with a shudder, as though they must of necessity burn up all the coils of the instruments, and burst all the cables; but this machine clearly shows that this is but a gigantic Brocken shadow of the imagination that has frightened them.

We have tested this machine against the regular batteries used in telegraphy. We took a battery of sixty cells, the number used on the London, Chatham, and Dover Railway Telegraph line, to telegraph between London and Dover, and found on the Peltier electrometer that they had a mean tension of 12°, and on the galvanometer a quantity of 45°. The machine gave a mean tension on the Peltier of $8\frac{1}{2}$°, and on the galvanometer a quantity of 35°. Of course we need not tell electricians that the true ratios of tension are the square roots of 12 to $8\frac{1}{2}$—that is, $\sqrt{12} : \sqrt{8\frac{1}{2}} = 3{\cdot}46 : 2{\cdot}91$—which will make the tension of the machine equal to about fifty cells Daniel.

The quantity, of course, is in the simple ratio; that is, 45 : 35. Now, by calculation, taking the same ratios as for the tension, we get 45 : 35·9, which is nine-tenths of a degree more than our reading of the galvanometer gave us; showing plainly that the quantity and tension of this machine is governed by the same law as those of batteries. The machine was then put on the line, and spoke through to Dover very satisfactorily, though, of course, not quite so strongly as the sixty-cell battery, but more strongly than our testings would have led us to suspect. This line is eighty-two miles long, and there are twelve instruments in circuit upon it, each instrument having a resistance of six miles, that is, seventy-two miles; together the resistance is 154 miles,—a very adequate test for a machine of that tension.

To work a Morse by this machine, a reversary key and shunt are required to send a slight reversal through the instrument; but in a machine made expressly for working a Morse that would not be required.

In telegraphing electrolyticly the current from the machine decomposes nitrate of manganese quickly and strongly through 300 miles, and will do it very easily, but more faintly, through twice that distance; and all this is done with from four to six cells, and the inventor sees wherein he can modify the coils, that with half the number of cells he can get the same results.

THE OLD TELEGRAPHS.

Among the still primitive people of Montenegro a plan of transmitting information prevails which may be considered the rudest system of telegraphy still existing. When a shepherd in the mountains finds himself in want of society, he sends out at random a peculiar kind of yell, with a view of attracting the attention of any one similarly situated who may chance to be within hearing upon some other mountain side, and may also feel a desire for conversation. It is well known at what a great distance shrill sounds may be distinctly heard in these mountainous regions. The unseen friend, whose ears have caught the sound, responds in the same way, and then begins a dialogue about their flocks and herds, or any other country gossip; and should there chance to be news of public interest, such as of any important person or foreigner passing that way, the receiver of the intelligence shouts it out in the open air for the benefit of the mountain nearest to him, and so

it passes from one to another through a considerable part of the country. "This practice of calling from hill to hill," says a recent traveller, "also answers the purpose of an advertisement in a newspaper, and that with wonderful celerity. At any given time one-half of this badly-housed population may mostly be found in the open air, and their ears are astonishingly quick at catching these sounds. Any one who yells out his requirements may generally calculate on some one who has nothing else to do repeating them for him to the next living telegraph. An acquaintance told me he was once in want of a mule that was at the time grazing in the mountains more than ten miles off. He accordingly began the hue-and-cry: 'Ho! ho! you people there in the village of Brelizzu! High up in the mountains of Glenbotich, by the great beech tree with the withered boughs, the little lad Yanko is keeping my white-footed mule. Let him know that he is to come with it down to the road as fast as he can.' Thus the owner of the mule yelled at random into the air, and immediately some living echo took up his words, repeating them exactly; and so the message went till it reached the boy, and the owner of the mule found it waiting for him at the appointed place."

Beacon-fires were the ancient mode of telegraphy adopted in Great Britain, and in an act of the Scottish Parliament of 1455 it is directed that "one bale or fagot shall be warning of the approach of the English in any manner, two bales that they are *coming indeed*, and four bales blazing beside each other, that the enemy are in great force." The famous Bishop Wilkins, who pretended to discover the art of flying, describes certain alphabetic systems of transmitting information, which depended merely upon the number and alternate display or concealment of lights. The Marquis of Worcester, in 1663, described a system by which, as he said, a man at a window, as far as the eye could discover black and white, could hold discourse with his correspondent; and the ingenious Dr. Hook, in 1684, explained to a meeting of the Royal Society a scheme for communicating one's mind at distances of thirty, forty, a hundred, or a hundred and twenty miles, "in as short a time almost as a man can write what he would have sent." His plan required the use of the telescope, and was, of course, dependent on weather and various accidents; but this was the germ of the old semaphore which was actually used by our Government, and was at work in this country as late as 1852 between Liverpool and Holyhead. About twenty years after Hook's scheme was unfolded, an inventor, named Amontous, brought forward a similar plan in France. Persons were placed by him in several stations, at a certain distance from one another, and by the help of a telescope a man in one station was enabled to see a signal in the next before him. He was then required immediately to make the same signal, so that it might be seen by persons in the station after him. The signals used were either large letters of the alphabet or figures of various shapes to represent them. Amontous publicly demonstrated the practicability of his plan; but no system of signals was applied to any useful purpose till the period of the French Revolution. The telegraph then brought into use, in either 1793 or 1794, was the invention of M. Chappé, and, though similar in principle to the machine invented by Hook, it was greatly superior. The roof of the Louvre was his telegraphic terminus, and Chappé, having received from the Revolutionary Government a message to be forwarded to the army at Lille, he gave an understood signal to the heights of Montmartre, which was the second station, to prepare. At each station there was a watch-tower where telescopes were fixed, and the person on watch gave the signal of preparation throughout the line. The watcher at Montmartre then received, letter by letter, the sentence from the Louvre, which he repeated by his own machinery, and this was again repeated from the next height with as much rapidity as possible, until the message arrived at Lille. The upright post which was erected on the Louvre had at the top two transverse arms, movable in any direction by a single piece of mechanism. Chappé invented a number of positions for these arms, which stood as signs for the letters of the alphabet, and even these were reduced as much as possible. The signs, too, were arbitrary, so that they could be changed every week, all that was necessary being that the persons at each terminus should have the key. Two working models of this instrument were made at Frankfort, and sent by Mr. W. Playfair to the Duke of York, and thus the plan and the alphabet of the instrument came to England. Chappé was not more fortunate than other inventors in escaping opposition and discouragement. The people were prejudiced against the new machinery. His first instrument and station were destroyed by the populace; his second was burned to the ground, the unfortunate inventor narrowly escaping from the mob with his life; but the telegraph was subsequently taken up by the French Government, and became extensively used on the Continent.

This kind of telegraph, known as the aerial, was first established in England seventy years ago, a line of stations being formed from the Admiralty at Whitehall to the sea-coast, and information was thus conveyed from London to Dover in ten minutes. The expense of working and mounting the line from London to Portsmouth was £3,300 per annum. Though of great service to the Government, this old cumbrous system was, of course, only available in clear weather. Vexatious interruptions continually took place, and droll accidents occasionally resulted from the sudden cessation of communication, from a fog or similar cause, during the transmission of a message. When the British army were fighting under Wellington in Spain, news was anxiously expected from that great commander through the Admiralty signals. The public were in a state of feverish excitement, when one day the disastrous message was received: "Wellington defeated." The funds were violently agitated, the people and the Government were bewildered, and terrible rumours of enormous slaughter and great loss of guns, colours, and ammunition, were heard on all sides. It turned out, however, that just as the word "defeated" had been deciphered at some part of the line, a sudden mist had come on and cut off the remainder of the message. When this inopportune visitor had passed away, the public mind was instantly relieved with the news that the message was not "Wellington defeated," but "Wellington defeated *the French*."

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

V.

A.D. 1675.—Otto Guericke was contemporary with Boyle. He added the following discoveries to electric science:—An electrical machine with a globe of sulphur as the substance to be excited; the discovery of the light and sound accompanying strong electrical excitation; electrical repulsion; and that light bodies suspended within the sphere of action of an excited electric themselves become possessed of electrical excitation. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 43.)

A.D. 1676.—Mr. Haward, in 1676, relates of Grofton, master of the ship in which the circumstance occurred, that a violent thunderstorm reversed the polarity of the compass needles. (See *Philosophical Transactions*, July 18, 1676, pp. 647, 648; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 118.)

A.D. 1700.—Du Verney, in 1700, knew that the limbs of a frog are convulsed by the action of electricity. (See *Histoire de l'Académie Royale des Sciences*, 1700, p. 40; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 220.)

A.D. 1705.—Hawksbee used a glass electrical machine (1709), and made many experiments in respect to electric light. His discoveries extend from 1705 to 1711. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 43-45.)

A.D. 1707.—J. G. S., in 1707, published a German book, entitled, "Curious Speculations during Sleepless Nights." In this work occurs a notice of the electricity of the tourmaline as developed by heat. He affirms that the Dutch brought the tourmaline from Ceylon in 1703. (See Beckmann's *History of Inventions*, Vol. I., p. 89.)

A.D. 1708.—Dr. Wall, in the "Philosophical Transactions" for 1708, remarks, respecting the light and sound attendant upon the electrical excitation of a large stick of amber, as follows:—"This light and crackling seems in some degree to represent thunder and lightning. (See Bakewell's *Electric Science*, p. 12; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 44.)

A.D. 1720.—Grey and Wheeler's experiments extend from 1720 to 1736. The discoveries relating to tension electricity which these experiments embrace are as follows:—The ability to electrically excite metals when they are insulated (1729-31); that the human body is a conductor of electricity (1731); that when sulphur is fused and suffered to cool, it acquires a strong electrical property, particularly when it is cast in glass—certain resins have also a similar property; that the glass in which the sulphur is cast is also electrical; and that bodies may be preserved for months in an electrically excited state by wrapping them in worsted (1732). "Mr. Stephen Gray, just before he died, hit upon an experiment which seemed to indicate, that the attractive power which regulates the motions of the heavenly bodies is of the *electric* kind. The

experiment was this: he fixed a large, round, iron ball upon the middle of a large cake of rosin and wax; and exciting the virtue strongly in the cake, a fine feather, suspended by a thread, and held near the iron ball, was carried round it by the effluvia in a circular manner, and performed several revolutions: it moved the same way with the planets, from west to east, and its motion, like theirs, was not quite circular, but a little elliptical." (See *Encyclopædia Metropolitana*, Vol. IV., art Electricity, pp. 45-47; also *A new Universal History of Arts and Sciences*, Vol. I., art. Electricity, pp. 460, 461.)

A.D. 1729.—Gray and Wheeler, in February, 1729, produced motion in light bodies at a distance of 666 feet by means of frictional electricity. This experiment was tried with a view to ascertain the distance through which the electric force could be transmitted; it thus possesses an interest in connection with electric telegraphs. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 45, 46; also *Saturday Review*, August 21, 1858, p. 190.)

A.D. 1733.—Du Fay's experiments extend from 1733 to 1737. His discoveries are as follows:—That all insulated bodies may be electrically excited more or less; "that all electric bodies attract all that are not so, and repel them as soon as they become electric by the vicinity or contact of the electric body;" and that there are two distinct developments of electricity, one from excited glass, and the other from excited resin; bodies being electrified by the same substance repel one another, by opposite substances attract one another. Du Fay thus originated his dual theory of electricity. In some experiments Du Fay was assisted by the Abbé Nollet. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 46, 47.)

A.D. 1734.—Swedenborg, in 1734, in his "Principia," puts forward the following theoretical views in advance of the age in which he lived, and of interest to electricians:—1. Electrical effects are referred to a force less subtile than that producing magnetic effects. 2. Electrical effects are said to be produced by the gyration (movement in a spiral, helical, or circular path) excited by the tremulation of the particles of bodies. 3. Lightning is referred to the same origin as electricity. 4. Other polar forces besides magnetism are recognized, and amongst them electricity. 5. All forces moving in a spiral or helical path, and therefore magnetic and electric forces, vary in the inverse duplicate ratio of the distances. (See *Principia Rerum Naturalium, sive Novorum Tentaminum Phænomena Mundi, elementaris philosophice explicandi*. Fol. Dresden, 1734, in Vol. I. of "Swedenburgii Opera," pp. 410, 409, 427, 48, 49, 81, 60, 61.)

A.D. 1741.—Boze, in 1741, introduced the prime conductor, suspended from silk threads to the electrical machine, and "proved by many experiments that the weight of bodies was not affected by giving to them, or abstracting from them, electricity." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48.)

A.D. 1741.—Winkler, in 1741, in the electrical machine "substituted a cushion for a rubber instead of the hand." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48.)

A.D. 1742.—Dr. Desaguliers, in 1742, published an essay on electricity, in which he "distinctly divided bodies into "*electrics* and *non-electrics* or conductors;" he also accounted "for the superior success of electrical experiments in frosty weather, and in dry states of the atmosphere," by attributing it to the conducting properties of the vapour of water. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 47, 48.)

A.D. 1742.—Mr. Gordon, about 1742, used a glass cylinder for an electrical machine instead of a globe. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48.)

A.D. 1744.—Ludolf, of Berlin, about 1744, ignited combustible substances by the electric spark. He set fire "to the ethereal spirit of Frobenius." (See *Encyclopædia Britannica*, 8th edition, art. Electricity, p. 526; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48.)

A.D. 1745.—Dr. Miles, "observed the pencil of luminous rays proceeding from an excited electric, even without the approach of a conducting body." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48.)

A.D. 1745.—Dr. Watson, in 1745, made some experiments and researches respecting the electric spark, and "showed that in electrifying conductors of considerable extent, electricity is first developed at that part which is most remote from the excited electric." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48.)

A.D. 1745, 1746.—Muschenbroek and Kleist, in 1745, simultaneously discovered the Leyden jar. According to Dalibard, however, the inventor's name was Cuneus (1746). Exaggerated accounts were given of the effects of the shock from the Leyden jar by these philosophers; public attention was thereby drawn to the subject of electricity more by this than by any previous discovery. The Leyden jar was perfected by Sir W. Watson, Smeaton, Bevis, Wilson, and Canton. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 48; also Bakewell's *Electric Science*, pp. 14-17; also Sir W. Snow Harris' *Rudimentary Electricity*, pp. 58-74.)

A.D. 1746.—Dr. Watson, in 1746, proposed a single-fluid theory of electricity very like that of Dr. Franklin's. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 49.)

A.D. 1746.—Le Monnier, in 1746, showed that electricity was communicated to homogeneous bodies in proportion to their surfaces. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 49.)

A.D. 1746.—The Abbé Nollet, in 1746, found that electricity accelerates the efflux of fluids through capillary tubes. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 49.)

A.D. 1746.—Mr. Maimbray, at Edinburgh, in October, 1746, electrified two myrtle trees for a month, and found them put forth leaves and blossoms sooner than those that had not been electrified. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 49.)

A.D. 1747.—Pivati, in 1747, stated that the effect of medicines was conveyed through electrified glass tubes; it was afterwards found, however, that the electric force in this case performed the alleged cures. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 50.)

A.D. 1747.—Franklin's first communication to Mr. Peter Collinson, of the Royal Society, is dated March 28th, 1747. In these series of communications he propounds his single-fluid electrical theory. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 50.)

A.D. 1747.—Dr. Watson, in 1747, in the presence of many scientific persons, transmitted electricity through 2,800 feet of wire, and 8,000 feet of water, thus making use of the *earth circuit*. This fact is interesting in a telegraphic point of view. (See Highton's *Electric Telegraph*, p. 11.)

A.D. 1748.—Benjamin Franklin, in 1748, performed his celebrated experiments on the banks of the Schuylkill in North America. These experiments "were concluded by a pic-nic, when spirits were fired by an electric spark sent through the river, and a turkey was killed by the electric shock and roasted by the electric jack before a fire kindled by the electrified bottle." (See *Penny Cyclopædia*, Supplement 2; also *Saturday Review*, August 21, 1858, p. 190.)

A.D. 1748.—Jallabert, at Geneva, since 1748, "entertained the idea of submitting some invalids to electrical treatment, by drawing sparks from different parts of their body, which he brought near to the conductor of an electrical machine." Paralysis in the right arm was ameliorated by this means. (See De la Rive's *Treatise on Electricity*, Vol. III., p. 586.)

A.D. 1751.—Canton's discoveries range from 1751 to 1762. They are as follows:—That the excitement of positive or of negative electricity depends upon the rubber used, as well as upon the electric rubbed, and upon the condition of its surface; that a body of air in a state of rest can be electrified; and that an amalgam of tin can be applied advantageously to the cushion of an electrical machine. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 52.)

A.D. 1752.—M. Dalibard, in 1752, erected a lightning rod, and sparks from it were first observed by his assistant on May 10th. (See Bakewell's *Electric Science*, p. 21; also De la Rive's *Treatise on Electricity*, Vol. III., p. 92.)

A.D. 1752.—M. de Romas, in 1752, elevated an electrical kite, and obtained proofs of the existence of atmospheric electricity. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 134; also De la Rive's *Treatise on Electricity*, Vol. III., p. 92.)

A.D. 1752.—Franklin, in June, 1752, proved the identity of lightning and electricity at Philadelphia by his celebrated kite experiment. He immediately applied this discovery to useful purposes by inventing metallic conductors to protect buildings from the effects of lightning. (See Bakewell's *Electric Science*, p. 22; also De la Rive's *Treatise on Electricity*, Vol. III., pp. 91, 92; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 134, 135.)

A.D. 1753.—Professor Richmann, of St. Petersburg, in August, 1753, fell a victim to his experiments upon lightning, being killed by a thunder-clap whilst examining its effects upon an electrometer

of his own construction. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 52; also Bakewell's *Electric Science*, pp. 23, 24.)

A.D. 1753.—C. M., of Renfrew (Charles Marshall, of Paisley?) wrote a letter, dated February 1st, 1753, "to the author of the 'Scots' Magazine,'" proposing a plan for an electric telegraph. The insulated wires were supposed to be stretched in the air, and were to be equal in number to the letters of the alphabet; the signals were given by the rising of pieces of paper (bearing the letters) to electrified balls, or by the passage of a spark to certain bells, one bell answering to each letter of the alphabet. According to another method, the characters were kept constantly in contact with the balls by the continual passage of electricity through the line wire, except when a signal was to be conveyed, at which time the wire corresponding to the letter to be telegraphed was removed from the source of electricity at the transmitting station. Sir David Brewster shows that it is very probable that the "C. M." of Renfrew is identical with the "Charles Marshall," of Paisley—a person of whom an aged lady says, that he was a very clever man, who had formerly resided in Renfrew, and who could "make lightning speak and write upon a wall." (See *The Engineer*, December 24th, 1858; also a number of the *Commonwealth* (Glasgow newspaper); also *Chambers' Journal*, January 15th, 1859, pp. 47, 48.)

A.D. 1753.—Beccaria, in 1753, published the results of his experiments; they related to the speed of transmission of electricity through various media, and showed particularly the imperfect conducting power of water. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 52.)

A.D. 1759.—Mr. Delaval, between the years 1759 and 1764, communicated to the Royal Society certain experiments to ascertain "the conducting powers of the same body in different states." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 53.)

A.D. 1759.—Æpinus, in 1759, announced the production of electricity by heating the tourmaline, and that opposite electricities were developed in opposite points of the stone. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 53.)

A.D. 1759.—Mr. Robert Symmer, in 1759, in communication to the Royal Society, advanced the theory that there are two electric fluids, but that they are not independent of one another, as Du Fay supposed; on the contrary, they are co-existent, and simultaneously developed by electrical excitation. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 53, 54.)

A.D. 1759.—Æpinus and Wilcke, in 1759, electrified "two surfaces of a plate of air, so as to obtain a shock from the discharge of these surfaces, exactly on the principle of the Leyden jar." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 54.)

A.D. 1759.—Æpinus, in his "Tentamen Theoriæ Electricitatis et Magnetismi," published at St. Petersburgh in 1759, brought mathematical science to bear upon Franklin's single-fluid theory. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 54.)

A.D. 1760.—Canton, in 1760, discovered the electric excitability of the topaz upon the application of heat. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 132.)

A.D. 1762.—M. Sulzer, in his "Theory of Agreeable and Disagreeable Sensations," published at Berlin in 1762, noticed the peculiar sensation occasioned by a piece of silver and a piece of lead in contact with each other and with the tongue, and thought this effect might result from solution of either of the metals. This sensation is now known to be an effect of electrolytic action. (See Bakewell's *Electric Science*, p. 29.)

A.D. 1767.—Lane's discharging electrometer was contrived about the year 1767.—(See Sir W. Snow Harris' *Rudimentary Electricity*, p. 86.)

A.D. 1767.—Joseph Bozolus (a Jesuit, and lecturer on natural philosophy at Rome) invented "a practicable system of telegraphing, similar to that of C. M." (See a Latin poem entitled *Mariani Parthenii Electricorum*, in VI. Libros, Roma, 1767, p. 34; also *Saturday Review*, August 21, 1858, p. 190.)

A.D. 1771.—Mr. Henry Eales, in 1771, "originated a doctrine of opposite electric forces." (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 33.)

A.D. 1772.—Mr. W. Henley, F.R.S., in 1772, invented the quadrant electrometer. He also invented a "universal discharger." (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 78.)

A.D. 1774.—Lesarge, in 1774, "employed 24 wires and a pith-ball electrometer," to communicate signals by frictional electricity. (See Highton's *Electric Telegraph*, pp. 38 and 40.)

A.D. 1776.—Mr. Cavendish, in 1776, described an artificial torpedo, with which he exhibited the ordinary properties of this fish. (See *Philosophical Transactions*, 1776; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 54.)

A.D. 1776.—Volta, in 1776, made known the properties of the electrophorus. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 55.)

A.D. 1776.—Van Marum, about 1776, employed an electrical machine, consisting of a circular disc of shellac. (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 46.)

A.D. 1777.—Lichtenberg, about 1777, published his discovery of the phenomena of "electrical figures." These figures are produced by sifting pulverized sulphur and minium on to electrized resin. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 101.)

A.D. 1777.—Beccaria, about the year 1777, "found that a needle through which he had sent an electric shock, had, in consequence, acquired a curious species of polarity; for instead of turning as usual to the north and south, it assumed a position of right angles to this, its two ends pointing to the east and west. (See *Library of Useful Knowledge*, Electro-magnetism, p. 3.)

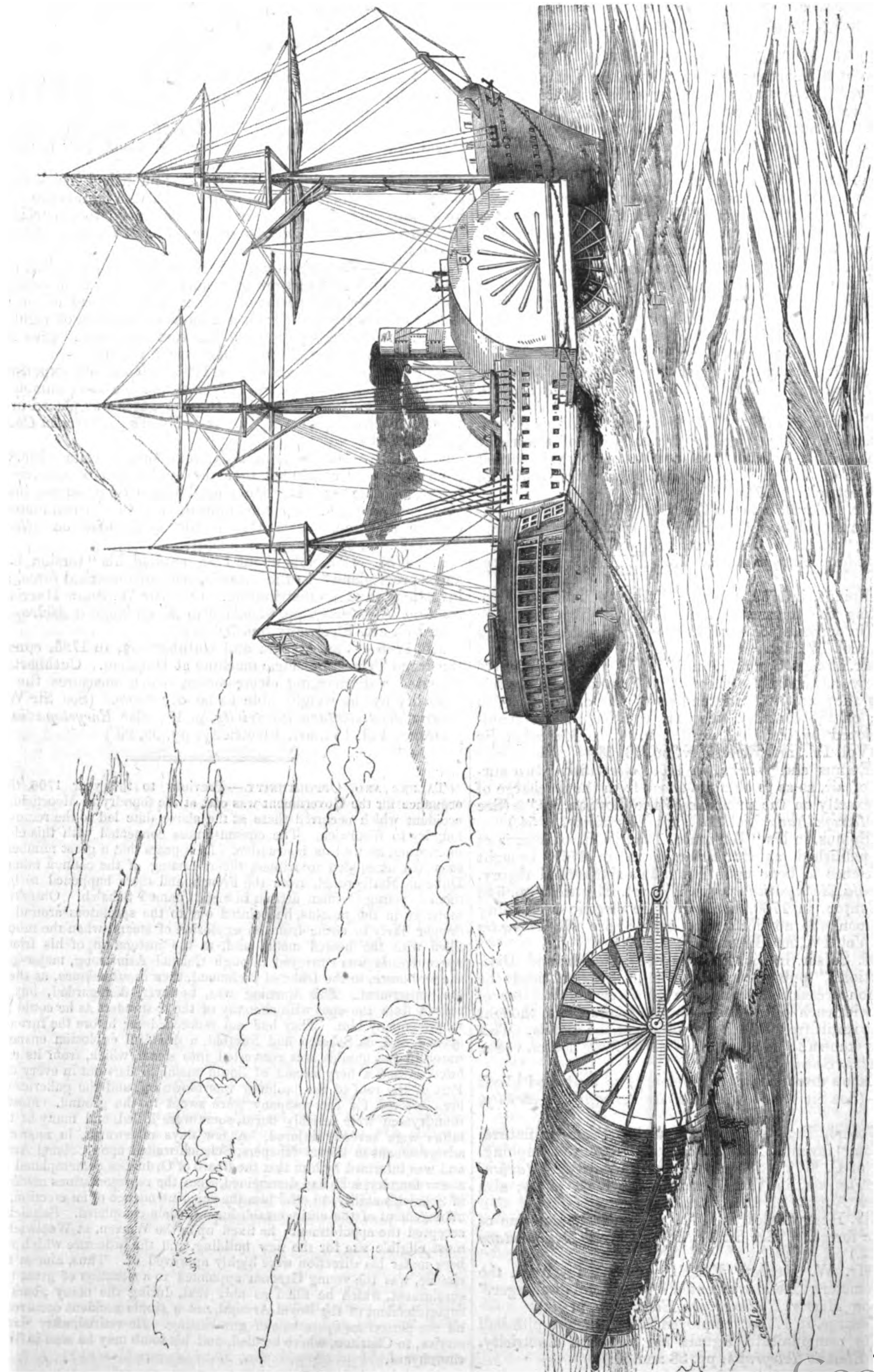
A.D. 1781.—Mr. Warltire, in 1781, related his experiment of producing water by the union of "inflammable and common air" to Dr. Priestley. The mixture of the two gases was placed in a close vessel, and fired by electricity. (See Noad's *Lectures on Chemistry*, pp. 182, 183.)

A.D. 1781.—Mauduyt, in 1781, published certain observations, from which he concluded that the application of electricity was favourable in paralysis. He placed the patient on an insulating stool, and put him into communication with the conductor of an electric machine. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 586, 587.)

A.D. 1785.—Coulomb, about 1785, applied his "torsion balance" and "proof plane" to the measurement of electrical force, and the investigation of its distribution. (See Sir W. Snow Harris' *Rudimentary Electricity*, pp. 81-83; also *Encyclæopdia Metropolitana*, Vol. IV., art. Electricity, pp. 70, 71.)

A.D. 1785.—Van Marum and Cuthbertson, in 1785, constructed the large Tylerian electric machine at Haarlem. Cuthbertson also invented a discharging electrometer, which measures the electric intensity by the weight able to be overcome. (See Sir W. Snow Harris '*Rudimentary Electricity*, p. 47; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 98, 99.)

TALENT AND OPPORTUNITY.—Previous to the year 1706 the brass ordnance for the Government was cast at the foundry in Moorfields, but an accident which occurred there at the above date led to the removal of the foundry to Woolwich. The circumstances connected with this change are interesting, as well as instructive. It appears that a great number of persons had assembled to witness the re-casting of the cannon taken by the Duke of Marlborough from the French, and there happened to be among them a young German artisan in metal, named Schalch. Observing some moisture in the moulds, he pointed out to the spectators around him the danger likely to ensue from an explosion of steam, when the moulds were filled with the heated metal, and, at the instigation of his friends, this apprehension was conveyed through Colonel Armstrong, major-general of the Ordnance, to the Duke of Richmond, then in attendance, as the head of the department. This warning was, however, disregarded, but Schalch retired from the spot with as many of the bystanders as he could persuade to accompany him. They had not proceeded far before the furnaces were opened, and, as Schalch had foretold, a dreadful explosion ensued. The water in the moulds was converted into steam, which, from its expansive force, caused a fiery stream of liquid metal to dart out in every direction. Part of the roof of the building was blown off, and the galleries that had been erected for the company were swept to the ground. Most of the foundrymen were terribly burnt, some were killed, and many of the spectators were severely injured. A few days afterwards, in answer to an advertisement in the newspapers, Schalch waited upon Colonel Armstrong, and was informed by him that the Board of Ordnance contemplated building a new foundry, and had determined, from the representations made to them of Schalch's ability, to offer him the superintendence of its erection, and the management of the entire establishment, when completed. Schalch readily accepted the appointment; he fixed upon the Warren, at Woolwich, as the most eligible site for the new building, and the ordnance which were cast here under his direction were highly approved of. Thus, almost by mere chance, was the young German appointed to a situation of great trust and emolument, which he filled so ably that, during the many years he was superintendent of the Royal Arsenal, not a single accident occurred amidst all the dangerous operations of gun-casting. He retired, after sixty years' service, to Charlton, where he died, and his tomb may be seen in Woolwich churchyard.



CAPTAIN SELWYN'S (R.N.) APPARATUS FOR PAYING OUT ELECTRIC TELEGRAPH CABLES.

FLOATING CYLINDERS.

By J. H. Selwyn, Captain R.N.

Some of our correspondents having expressed a wish that a full description of the proposed arrangement for laying submarine cables by Captain Jasper Selwyn, R.N., should appear in this journal, it affords us much pleasure in thus being able to comply with the request. We believe that it is intended to construct a cylinder of considerable dimensions with the view of practically testing its applicability and efficiency for the purpose :—

One, two, or more cylinders, if preferred, of plate iron, ½-inch thick, are constructed to carry such portion or portions of the cable to be laid as may be thought desirable; but as it is most convenient to make the necessary calculations on some known basis, the old Atlantic cable will be first taken as an illustration.

That cable weighs one ton per mile in air; in water, 14 cwt.

Its diameter is ⅝ths of an inch.

Its cost about £100 per mile.

The distance laid is 2,022 miles, and the distance between Valentia, Ireland, and Trinity Bay, Newfoundland, is 1,650 nautical miles; 3,000 miles will be taken as necessary in these calculations.

The size of cylinder, with paddle wheels attached, which will carry 1,500 tons, or half the cable, at less than half immersion, say about 20 feet draught, is 60 feet long and 50 feet diameter, this gives a tonnage of 3,366.

Of ½-inch iron plate throughout with double ends, 3 partitions, wheels, frame and stays, rivets, angle iron, &c., the rough estimate of weight is 300 tons, which at £20 per ton (to allow for manufacturer's profit) will be £6,000 total cost.

But the present light cables may be carried at considerably less expense, if, indeed, one or two thousand pounds be considered an object in carrying a cable, whose cost must be reckoned by hundreds of thousands, and in which a difference of 6d. per lb. in the expense of manufacturing the gutta-percha would more than cover the whole of the cost of laying by these means, that difference (as 400 lbs. of gutta-percha are used in each mile of 3,000 miles) being equal to £30,000.

The draught of water of such a cylinder will be about 6 feet when light, and it would in that state take a weight of 5 tons at 10 feet from the centre to deflect it one quarter of a degree from the horizontal. It may be proved by hydrostatic pressure, as is done with steam boilers, and it may be made to pump itself out whenever revolving.* Its resistance to towing will be considerable when not laying cable, but not sufficiently so to be really objectionable, as one steamer it is well known can tow another of her own size at a very small diminution of her speed. Many instances could be given of this fact, which is only a proof of the correctness of the theoretical axiom that the velocity of a ship varies as the cube root of the power, and *vice versâ*.

To put it in plainer language, if 800 horse-power propel a ship 10 knots, then two ships of equal size will be propelled by the same power acting in one of them, not 5 knots, but 8 nearly.

Note.—Captain Ericson's small screw vessel, of 45 feet length, 8 feet beam, and drawing 2 feet 3 inches of water, towed the American ship Toronto, of 630 tons burthen, on the Thames, 25th May, 1837, at the rate of 4½ knots per hour against tide.

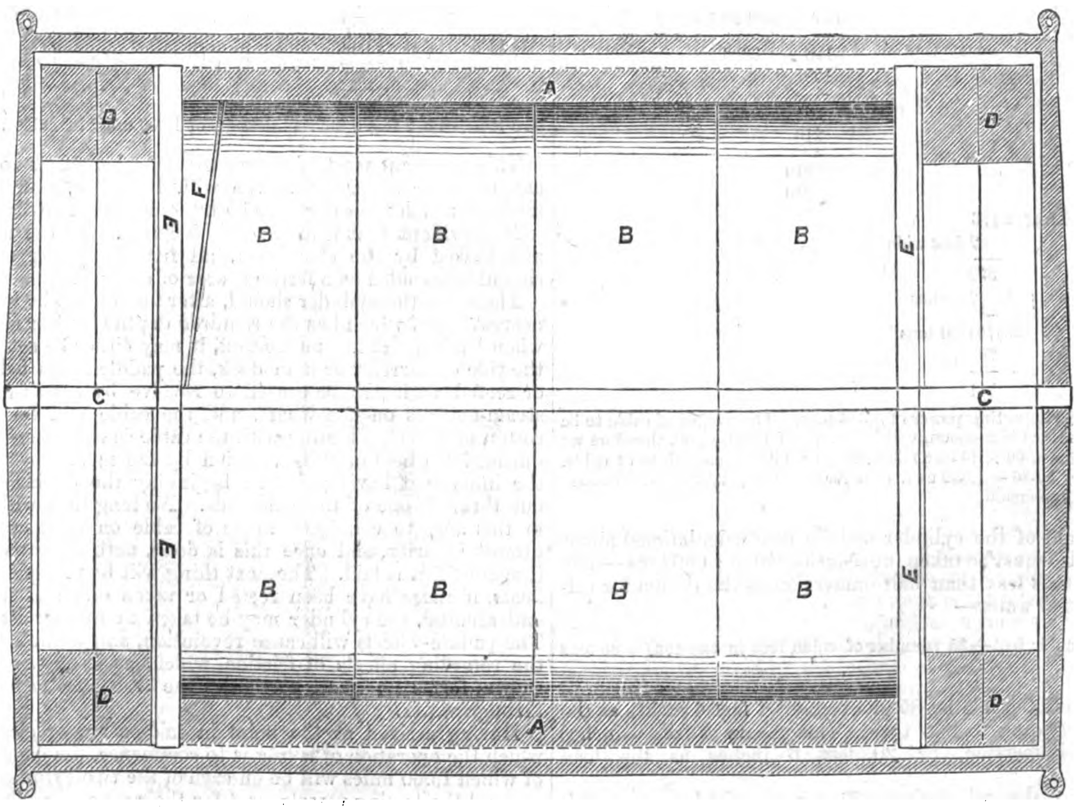
But the resistance is lessened during the laying of the cable by the fact, that with every mile thrown off the cylinder rises out of the water, and not only gives a less immersed midship section, but a better formed one, a smaller segment of a large circle.

The towing is also rendered less difficult than that of a ship by the fact that a cylinder so towed does not sheer about, or pitch and roll, these being the great causes of jerks and strains, which often break the towing cables.

If a gale of wind come on during the laying, not only is all anxiety about the ship and crew done away with, but even if separated from the towing vessel altogether no breakage of the cable could take place, for the cylinder is always free to revolve in answer to a steady strain, and there being no pitching or rolling, no other strains need be apprehended.

* Paddles are attached to each end, and it has a frame by which it is towed; the paddles cause and regulate its revolution.

FRAME BY WHICH CYLINDER IS TOWED.



Plan—Scale 1-16 in. to 1 foot.

A, Cable. B, Cylinder in four compartments. C, Axle hollow. D, Paddles. E, Double Ends. F, Tube through which inner end of Cable is led.

If during the laying the cable should by any accident be broken, means are provided (sufficiently simple in their character to give a fair chance of success) by which the cable may be caught and held, even miles astern of the ship, until she can go back, and picking it up, make a splice, and proceed anew. If the cylinder be cast off, or the tow ropes broken, so soon as any strain is felt upon the cable by the drift to leeward of the cylinder, the result will be that the cylinder will turn round and "ride to" the cable, veering slowly in answer to the strain, but resisting any rapid pulling off of cable by the beating of the paddles on the water. But with proper management this breaking adrift ought not to occur.

Arrangements are made for reefing or expanding the paddles during revolution, so as to regulate the amount of slack or tightness of cable as desired. Also for testing through the cable electrically during the coiling on or laying, by passing the end of the cable, which is first coiled on, out through one of the axles; there it is allowed to turn freely, in contact with a spring, or dipping into a cup of mercury, as preferred. To give a familiar idea of the size of the cylinder, it may be stated that it is about as long as an ordinary coal-barge on the Thames, or a little less than the distance between any two neighbouring lamp-posts along the street. It has been stated that the size of cylinder for such a cable as the late Atlantic would be 60 long × 50 diameter, that its weight was about 300 tons, and the total cost about £6,000. We will now proceed to give the details of these calculations of weight and cost of cylinder for carrying a submarine telegraphic cable, such as the old Atlantic:—

	Ton	cwt.	qr.
Weight in air per mile	1	0	0
Weight in water per mile	0	14	0
Diameter	⅝-inch.		
Length	3,000 miles.		

This can be carried thus. Two cylinders are to be built of ½-inch iron, each 60 feet long by 50 feet diameter, with double ends 2 feet apart, and paddle-wheels attached, the ends to have a diameter of 56 feet, and the whole to be surrounded by a frame, in which the axles revolve. The tonnage of each of these will be as follows:—

```
                 Area of 50 feet = 196350
                                   60 length
Cubic feet in one ton 35)11781000(3366 tons burthen
                         105        add 20 for ends
                         128        3386
                         105
                          231
                          210
                           210
                           210
Ends area of 56 feet = 176
                     2 feet wide
                     352
                     2 inches
                 35)704(20 tons
                    70
                     4
```

Thus we get a total supporting power of 3,386 tons. The weight of cable to be carried at, say, one-third immersion, will be thus, ⅓ of 1,500 = 500, therefore we have 1,000 tons plus (500 × 14 cwt.) 350 tons, or 1,350 tons weight of cable. The gross tonnage 3,386 — 1,350 cwt. of cable = 2,036; 2,036 — 1,350 = 685 tons less than half immersion.

Now the weight of the cylinder will be (see calculations) about 300 tons; this also must be taken into consideration; 686 tons — 300 tons leaves 386 tons less than half-immersion as the datum for calculating draught of water—

60 × 50 = 3000 cubic feet ÷ 35 (number of cubic feet in one ton) = 85 tons for the first foot.

Now, roughly dividing 386 by 85 gives about 4 feet 6 inches as the draught corresponding to 386 tons. This means 4 feet 6 inches less than half-immersion, or 20 feet 6 inches as the load draught.

Next we take the calculations of weight, which are as follows:—

Barrel.

Length of Cylinder.		Circumference of 50 ft. diameter.				1¼-inch. No. of lbs. in 1 sq. ft.		Weight of Barrel.
60 feet	×	157,080	=	94,248	×	20	=	188,496 lbs.

3 Partitions.

	Area.		In No.					Weight of Partitions.
50 feet	= 196,350	×	3	= 589,050	×	20	=	117,810 lbs.

4 Ends, 56 Feet Diameter.

	Area.		In No.					Weight of Ends.
56 feet	= 246,301	×	4	= 985,204	×	20	=	197,040 lbs.

Assumed weight of frame, wheels, stays, rivets, angle iron, cuttings, &c., 80 tons, or = 179,200

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2240)682,546(304½ tons
     672
      1054
       896
       158
       224
```

Total weight of cylinders and attachments 304 tons, multiplied by £20 per ton to get probable total cost, gives £6,080.

Next there is the calculation of the thickness of cable when reeled on cylinder, the total number of miles in one layer, and the number of layers on the cylinder when 1,500 miles are coiled on:—

Diameter of cable, ⅝ths of an inch; length, 1,500 miles; mean diameter of cylinder and cable, 52 feet; length of barrel, 60 feet.
Then

```
Circumference of 52 feet                         = 163·36
Number of turns of ⅝ths of an inch in 60 feet      1153·4
                                  1153·4
                                  163·36
                                  69204
                                 34602
                                34602
                               69204
                              11534
No. of feet in one nautical mile 6082)188409·424(30·9
                                      18246
                                        59594
                                        54728
Miles of Cable.
30·9)1500·0(48·5 layers
     1236
      2640
      2472
       1680
       3090
```

48·5 × 5 ÷ 8 = 2 feet 6 inches thickness of 1,500 miles of cable when reeled on.

This sums up most of the necessary calculations so far as they can be made at present. We will, therefore, now consider the mode in which the cable is to be treated on these cylinders.

It is evident that when a cable is finished by the manufacturer, and passed by the electrician, all further coiling and uncoiling should be avoided as a fertile source of damage.

Therefore the cylinder should, after launching, be brought to the nearest wharf which has the required depth of water for its flotation when loaded. Being moored off, it may either be set in motion by the tide or current, or if in dock, the paddle floats being taken off or reefed in, it may be caused to revolve by bands from portable steam-engines on the wharf, and the cable will be coiled on as cotton on a reel. Testing with the cable *in water* can be carried on during the whole of this operation by the means before spoken of, the inner end having (before beginning the coiling) been passed out through one of the axle-ends. No long time will be required in this way to coil 1,500 miles of cable on each cylinder in the utmost security, and once this is done, nothing but water touches it again till it is laid. The next thing will be to replace the paddle floats, if these have been reefed or taken off; and now, with the end secured, the cylinder may be taken in tow for its destination. The paddle-wheels will cause revolution, and diminish by so much the retarding effects of friction, which, as Professor Rankine has shown, forms no small portion of the resistance to bodies passing through water.

Having arrived at the point in mid-ocean, or elsewhere, from which the operation of laying is to commence, the ends of the cable, of which 1,500 miles will be on each of the two cylinders, are joined up, and the towing vessels start for their respective shores.

It would at first sight appear that great difficulty will be expe-

rienced in towing so large a body, broadside on, as it were; but so far from this being the case, serious fears were entertained by one of our best mathematicians lest the cylinder in deep water, with a very heavy cable, should go at such a speed by itself as to "run over the ship." It is scarcely, however, necessary to consider this possibility—admitting that it does exist—because no very heavy cable need be laid in such a depth. One ton per mile will be quite as much as will ever be tried for crossing the Atlantic, and it is probable that even this is very unnecessarily heavy.

Let us, however, examine why it *is* possible, under certain circumstances, for the cylinder to run over the ship.

The descending cable weighing, be it recollected, even in water, 14 cwt. per mile, operates on the cylinder exactly as does the weight on the barrel of a clock movement.

It sets the barrel or cylinder in revolution, and this revolution is always tending to increase in velocity until the depth of water, and consequently the weight suspended, diminishes.

But this revolution cannot take place without causing the paddles to strike the water, and thereby propel the cylinder.

Given a depth of water two miles, weight of cable 14 cwt. in water per mile, then 28 cwt. are constantly applied to the rim of a wheel whose diameter is 50 feet, tending to turn it round in the water, which tendency being resisted by the paddle floats, causes forward movement of the whole body.

But it must be remembered that this will only take place so long as the cable is perpendicular in its descent. When this is altered by the forward movement of the ship towing, and the angle of 45° is passed, the backward pull becomes equal to the forward impulse, and no other effect is produced than a resistance by the paddles to the pull due to the weight of cable.

The result of all this is, that if the ship be able to go fast, the weight of cable does not assist her; if, on the contrary, she be reduced to the two-miles-an-hour speed, which is about the rate at which the cable can sink, then the whole effort from this cause will come in aid of the engines towing.

To return to the operation of laying. Any speed judged desirable, or which the towing vessel is able to accomplish, may be kept up regularly and without danger. A speed of 10 knots would cause the cylinder to revolve at the rate of about six turns per minute, or the outside of the cylinder would have speed of 1013·6 feet in a minute, which for a paddle-wheel is not excessive, the Great Eastern having considerably more. Supposing each ship to have gradually reached even this speed, and that the curve of cable between them were 100 miles, it is clear that any surge caused by a wave would be felt—first by the ship; next by the cylinder tow ropes, which will always have an elasticity due to the catenary curve in which they must hang, and then by the cylinder; last of all, and but slightly, by the cable, which is at no time absolutely checked in its unwinding.

When the pull comes on the cylinder the immediate result is to bring a greater turning force on the paddle floats, and thereby to give off more cable than the 10-knot speed required.

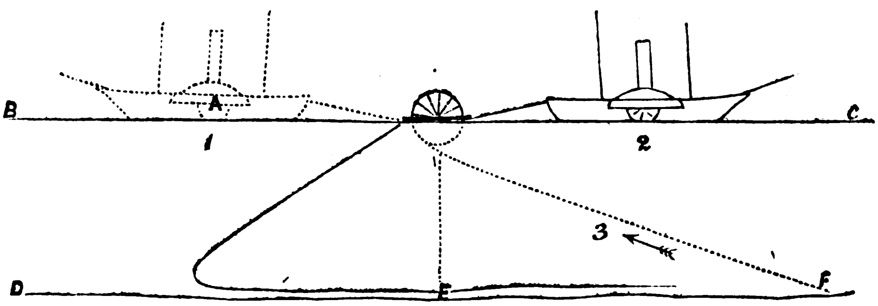
Further, to obviate any possible strain to the cable, there is a provision, as has before been stated, for expanding or reefing the paddle floats while towing, so that at will the diameter of the wheels which govern the revolutions can be increased or diminished relatively to the barrel of the cylinder, the result being that as much, or as little, slack is laid as may be proper.

But it is never a matter of necessity to continue the operation of laying, if the weather be such as to render it hazardous to do so. The ship need only "lie to," and either veer out a long scope of tow rope, or detach altogether, putting such brake power on the wheels of the cylinder as shall secure its not turning under a certain strain, to be less than half the breaking strain, and then waiting for more favourable weather.

If a leak should be feared in a structure which can be proved like a steam boiler, it is easy, by means of radial scoops internally, to make the cylinder pump itself out (as is done in the modern process of refining sugar) whenever it is revolving.

While there is great depth of water, and consequently great suspended weight of cable, the wheels will be deeply immersed, and great resistance will be opposed to any more cable being dragged off than the percentage of slack which has been decided on. If the depth alters, the resistance immediately increases or diminishes with it, by the weight of cable hanging under being also altered, and as the cable goes off the cylinder rises out of the water, opposes less resistance to towing, and has fewer floats immersed. As the shore is approached the draught of water will have lessened, so that the cylinder itself may, if requisite, be towed into the harbour, instead of a second shifting into boats, which may easily be a cause of damage.

The cylinder may also be easily used in either underrunning or picking up the cable for repairs. If, for instance, the cable were broken between the ships at the outset of the operation of laying, and by any mischance the means provided for catching the end did not take effect, then each ship would cast off her tow ropes, where they are hooked or joined to the foreside of the towing frame, and again make fast to the after or hinder part of the said frame. As soon as the ship again begins to tow, the cable will be wound *on* the cylinder, if sufficient velocity be attained to overcome the weight of cable due to the depth, by the resistance of the paddles; and this may be done, if necessary, in circles, taking care to follow the lay of the cable. It has been found, in performing this operation with the model, that the cable is picked up as shown in the diagram.



1. Ship laying. 2. Ship picking up. 3. Former line of laying.

What is meant, therefore, is, that if we think that the line from E to D is getting too long, instead of continuing towards C, we may tow round and round in circles, so as to pick up the cable without going on over that already laid, until the slack or loop from cylinder to D E is reeled on. In thus reeling up, either manual or mechanical means must be provided to guide the cable, so that the turns may not "ride" or overlay each other. But there is little reason to anticipate any necessity for this operation in deep water, where it is admitted that it would be attended with considerable difficulty, though even there not impracticable with a good cable, if the cable be only properly laid without kinks and without strain, as may be one by these means.

It will, perhaps, not be out of place to advert here to the nature of cable which should be used, and without going too much into particulars, shortly to state what are the absolute requisites for success.

It is evident that to the safety of the conductor and its insulator, after manufacture and testing, all other considerations must be subordinate; therefore, when the size and shape of these have been determined, any application by which there is even a remote chance of injuring them must not for an instant be allowed. Among the most prominent of these applications is the system of outer wires, which has, in all cables hitherto laid in deep water, contributed far more to their destruction than their protection, whether by causing heating in the hold of the vessel in which they were stowed, or weakness by their weight and liability to destruction at the bottom; whether viewed as the protecting arch, which they are not, or the mechanical fallacy, which they are, naked or with a skin of gutta-percha, spiral or in straight lines, they are an error, and must be abandoned.

Where, then, shall we look for strength? how shall we provide for raising *the cable we wish to lay?* Is it necessary to do so? Are

there any probabilities, not to say possibilities, of raising a great length of deep-water cable? Should we not rather provide for its safe deposition than for first breaking it, and then raising for repairs? Is it not the fact that all who think much on the subject agree in believing that a simple insulated copper wire would be the best after all, if it could be submerged without being subjected to strains? But if strength we must have (we are, of course, not now speaking of shore ends), then it is clear that it must be protected strength—strength as little liable to decay as possible, and the greatest in the least bulk. These conditions point unmistakeably to steel as the material, and contact with the conductor as the place for it. Then both conductor and strength are alike protected from the fatal admission of salt water. Then they will be inseparable during life, and in their deaths (if that unfortunately occur) not divided; then wire rope will not blame gutta-percha, nor will gutta-percha suffer from the too strict embraces of its hitherto faithless ally. We shall get no more shrugs of the shoulder over submarine telegraphy and its moral causes, our shares will be at a premium, and our shareholders will buy as well as sell.

A company is being formed in the full persuasion that they *can* see how to do it, as well as how not to do it, and it is confidently hoped that before many months elapse submarine telegraphy will again raise its voice, and look both friends and foes fairly in the face.

CORRESPONDENCE.

INDIA-RUBBER CABLES.

To the Editor of the Telegraphic Journal.

Sir,—Your correspondent "Beppo" has miserably failed in his attempt to controvert the damaging facts adduced by Mr. Henley and myself. He has not furnished a single instance in which india-rubber insulated wires have lasted for any length of time. The material has had ample opportunities and fair play to prove its efficiency, but under both experimental and practical tests it has proved itself inapplicable for the purpose of telegraphy. I ask again—"Can 'Beppo' prove the contrary?"—Your obedient servant,

R. Watson.

TELEGRAPHIC NEWS.

The Persian Gulf Cable.—From a telegram received from Bombay, viâ the Malta and Alexandria line, we are sorry to learn that the above cable has been broken; the particulars of the accident have not, however, yet been received at the India Office.

Tampering with Telegraphic Wires.—Placards were extensively issued, on Monday morning last, offering a reward of £50, on the part of the directors of the South-Eastern Railway Company, for the discovery of the person or persons who recently rendered the telegraphic communication on the North Kent line inefficient by means of connecting together, with a piece of copper wire, the wires relating to telegraphic instruments at the Woolwich Arsenal.

The Transatlantic Telegraph.—The telegraph across British North America, according to the *Montreal Gazette*, is progressing favourably. Dr. Rae, the Arctic explorer, employed by the Hudson's Bay Company to visit the country between between Red River and the Pacific coast, to select the proper line for the telegraph, reached Fort Garry about two months ago, and is now far on his way across the plains of the Saskatchewan. Seventy-seven tons of the wire, nearly half the quantity required, have arrived in Montreal. The wire is to be forwarded at once by the Grand Trunk Railway Company to Sarnia, and by steamboat to the head of Lake Superior, whence it will be transported during the winter to Fort Garry on the Red River, at which place the whole of the wire, instruments, insulators, &c., will be collected by the beginning of spring. The poles will be cut and got ready during the winter. As soon as the weather of next spring sets in active operations will be commenced, and by the close of the year 1865 there is every reason to expect that the telegraphic communication will be in operation from Fort Garry to the shores of the Pacific. The telegraphic system of the United States is in operation to within about 400 miles of Fort Garry. "This gap," says the same paper, "will certainly be at once filled, and the messages can pass from any part of Canada to British Columbia. Will not Canada be prepared to complete the communication between Fort Garry and Montreal by the Ottawa Valley, so as to have an unbroken line of telegraph stretching from the Atlantic to the Pacific through British territory? This active prosecution of the Pacific telegraph by the Hudson's Bay Company is the best evidence of their intention to inaugurate a new policy in their affairs. The progress of the telegraph with the company's posts every forty or fifty miles will be the surest means of opening up the country, and directing to the fertile territories of the Saskatchewan, the Assiniboine, and the Red River, a tide of settlement and population which will ultimately complete the chain of British colonies from one ocean to the other."

India Telegraph.—Col. Stewart, C.B., whose successful completion of the Persian Gulf telegraph we have already reported, arrived on Monday from Bombay, viâ Egypt. Lieut-Col. Goldsmith, who started almost simultaneously from Bagdad, on a mission of inspection of the land line thence to Constantinople, is also expected in the course of the week, having reached Angora on Monday. On the arrival of the latter officer, definitive arrangements will be made by Col. Stewart and him, in concert with Mr. Courtenay, the delegate of the Indian Government, for the regular working of the through Anglo-Indian service as soon as the line between Bagdad and Bussorah has been completed.

The American Army Telegraph.—The correspondent of the *New York Times* gives the following account of the army telegraph:—"The wires of the army telegraph are insulated, and may be unrolled, with great rapidity, from a winch in a waggon constructed for the purpose. As the waggon moves forward the wire is left to trail on the ground, or is placed upon light portable poles with pointed ends for thrusting into the soil, or is simply rested upon branches of trees by the roadside, as it threads its way through all the corps' head-quarters, and converges from every direction to the position of the general commanding. When the army moves the wire is taken up by the winch just as quickly as it was laid, and is ready for use at the next stopping place."

Telegraphic Communication between India, Singapore, China, Java, and Australia.—The project which has been for some years on foot for establishing a complete system of telegraphic communication between India, Singapore, China, Java, and Australia, is about to take the first step towards realisation. The Anglo-Australian and China Telegraph Company (Limited) have issued their prospectus for private circulation, and we understand that it will shortly be published. The present proposition is to to raise £450,000 for laying down a submarine cable between Rangoon and Singapore. This line will place India in direct telegraphic communication with Singapore and the Straits of Malacca, thus also reducing the time of communicating with Java, the Straits of Sunda, and China, to little more than the time occupied by the mail steamers between Singapore, Batavia, Hong Kong, and Shangai. The India and Singapore line will also enable news to be telegraphed to Galle and Bombay, in connection with the mail steamers which leave those ports five times a month. The shipping interests will be especially benefited by the India and Singapore line. Nearly the whole of the telegraphs proposed by the company can be laid in a moderate depth, say about fifty fathoms, the only portion of the seas proposed to be traversed that is not sounded being that which lies between the east end of Java and the Island of Timor. Everywhere else the moderate depth indicated is known to prevail, and that portion not sounded is only about 800 miles. Intermediate stations will be established every 400 to 500 miles, and the proposed submarine telegraph will be divided into sections of convenient lengths. Should the land line through Turkey or Persia prove efficient, the India and Singapore telegraph will place Europe in direct telegraphic communication with Singapore, but without relying upon those lines the efficient working of which has yet to be proved, the value of the proposed line will be very great, and will accommodate the important trade between India, Singapore, and China, and of the Straits Settlements, besides affording a communication with Galle and Bombay in connection with Europe. The Dutch government have granted a provisional subsidy for the extension of the proposed line from Singapore to Batavia, and the Australian colonies will no doubt recover the large subsidies voted or promised in 1860, when Mr. F. Gisborne proceeded to Australia to obtain financial assistance for a line from Java to Australia. The only existing line which affords any parallel to those proposed by the company is that which was laid three years ago by her Majesty's Government between Malta and Alexandria. The working of that line has been highly satisfactory. It has, indeed, been twice interrupted, but owing to the circumstance that it was laid in a moderate depth along the African coast, it was easily repaired on each occasion, the delay in effecting the repairs being due to the circumstance that there was no steamer available on the spot, and that a steamer had to be sent for to England. The receipts on the Malta and Alexandria line have increased in a most remarkable manner. Thus, in the first quarter of 1862 the gross receipts, according to the returns communicated to Parliament, were £6,853; in the last quarter of that year they rose to £11,958; again, in 1863, the gross receipts were £12,047, and in the last quarter of that year they again rose to £21,560. This latter sum is at the rate of 20 per cent. upon the cost of the line (£436,000). The net receipts are not given in the returns, but we understand them to have been 16 to 17 per cent. in the most favourable quarter. Telegraphs connecting distant countries obliterate all competition on the part of the post-office, and are certain to be highly remunerative, the necessity and inducement for telegraphing in such cases being imperative.—*Malta Observer*.

The Telegraphic Treaty between Hamburg and Holstein.—The following is the exact text of the telegraphic treaty concluded between the city of Hamburg and the Federal Commissioners for the Duchy of Holstein, to which exception is said to have been taken by Prussia:—Treaty for the regulation of telegraphic communication of the free Hanse Town of Hamburg with the Duchy of Holstein, and over the frontiers thereof, as well as with Cuxhaven.—As in consequence of the negotiations which have taken place by order of the Senate of the free Hanse Towns of Hamburg and Lübeck and the Federal Commissioners for the Duchies of Holstein and Lauenburg upon the conclusion of a treaty for the establish-

ment of telegraphic communication with Hamburg and Lübeck through Holstein, it appeared desirable to regulate at the same time the telegraphic communication of the free Hanse Town of Hamburg with the Duchy of Holstein and over its frontiers, as well as with Cuxhaven; the negotiations appointed by the Senate of the free Hanse Town of Hamburg and the Federal Commissioners—viz., Syndic Dr. Carl Hermann Merck and Governmental Councillor Carl Ernst Emil Lesser, Member of the Ducal Government at Kiel, have agreed to and concluded the following treaty, reserving its approval by their respective superiors. Section 1. The free Hanse town of Hamburg undertakes the obligation of forwarding telegraphic messages coming from and by way of Hamburg, and destined for a northerly direction, upon the line existing between Hamburg and Altona or upon a new line to be constructed, and binds itself to permit the Ducal telegraph administration to forward messages destined for Hamburg, and distances past that city upon the line to be maintained by Hamburg between Hamburg and Altona and through the Hamburg telegraphic offices. 2. For the use of the wires upon the Ducal State telegraph lines the Hamburg telegraph station shall pay to the Ducal Telegraph Administration 50 per cent. of the gross receipts, calculated according to the tariff in operation upon the Ducal State telegraph lines. On the other hand, 10 per cent. will be returned to the town of Hamburg as compensation for the works it will have to undertake to join the Ducal lines. 3. Permission shall be given to the free Hanse Town of Hamburg to establish telegraphic communication between Hamburg and Cuxhaven by submerging a cable from Cuxhaven to Brunsbüttel, and making use of the poles of the West Holstein telegraph line to carry the requisite wires. The works necessary for this purpose upon the West Holstein telegraph line shall be carried on under the direction of the Holstein Telegraph Administration, the costs hereby entailed being defrayed by Hamburg upon presentation of the account, while the maintenance of the line will be undertaken by the Holstein Telegraph Administration upon its own territory. 4. Provided, upon nearer examination, some other point upon the Holstein coast—as, for instance, Neufeld —shall be thought better adapted for the landing-place of the cable from the district of Ritzebüttel, the free Hanse Town of Hamburg shall be at liberty to land the cable there, and carry a telegraphic line to Brunsbüttel. 5. The free town of Hamburg shall pay the Holstein Telegraph Administration, as compensation for the concessions in sections 3 and 4, 25 per cent. of the gross receipts derivable from the transmission of private messages between Cuxhaven and Hamburg, and *vice versâ*, along the Hamburg and Cuxhaven line through Brunsbüttel. 6. Should an extension of the line past Cuxhaven take place, the private messages sent along the line passing through Holstein shall be paid for by handing over 25 per cent. of the Hamburg share of the tariff for that line to the Holstein Telegraph Administration. 7. This treaty shall be concluded for the term of ten years, from the 1st January, 1865, and shall continue in force for terms of similar duration, so long as notice of its cessation shall not have been given by either party six months prior to the expiration of one of the decimal periods. 8. This treaty shall be prepared in duplicate, and the exchange of the ratifications take place within four weeks at latest from the present date. Done at Hamburg, this 22nd July, 1864. (Signed) C. H. MERCK; DR. E. LESSER.

MISCELLANEA.

MAGNESIUM.—We hear that one of the *soirées* of the British Association, at Bath, is to be lighted up during the whole evening with burning magnesium wire. It is also anticipated that several places of business and amusement in London and the country will be occasionally illuminated during the coming winter by the same means. A magnesium metal company has been formed in Manchester, and their works are now in active operation in Salford.

UNPERCEIVED AGENTS.—Let the reader sum up the influences that meet in the room where he sits with our paper in his hand. There in that room is, first, the atmospheric air, with its oxygen, azote, carbon, hydrogen, and various gases. There is the light, with its green, yellow, scarlet, violet, and various component elements. There is gravitation connecting that room with every orb of immensity, one cord of which binds it to the sun, another to the moon, another to the planets and satellites, and others still to the most distant stars which twinkle on the mantle of night. These cords of influence, meeting and twining into a complicated network, now pervade the very space where the reader peruses this article, thus connecting him, by invisible ties, to the whole framework of nature. There, besides, is electricity, magnetism, galvanism, and how many more agents we know not. An electrical machine would reveal electricity, a magnetic needle magnetism, and a galvanic battery galvanism. Yet none of these powerful agents around you make you sensible of their presence, except as you learn the fact by the discoveries of science. In the same room your mind exists, with its world of interests and sympathies, and the minds, perhaps, of your family and friends. Each one has in this same space the passions, hopes, fears, loves, hatreds, aspirations, revulsions, and all the elements of distinct organic and spiritual life. Still, the mind of each one is a sanctuary upon which the others cannot obtrude, except so far as he shall admit them to share the secrets of his bosom. Each one is also destined to an immortality of life; so that in this room where you are reading are beings whose hopes grasp the infinite realities of a life to come, and connect them with the throne of God.

LIGHTNING CONDUCTORS.—At the May meeting of the Franklin Institute, Pennsylvania, America, Mr. James D. Rice submitted for examination several forms of lightning rod points, and made the following remarks:— "A new invention is not claimed for any of the lightning rod points exhibited, but simply a modification of a point constructed by Professor Robert T. Hare. Through the kindness of Judge Hare I have obtained this point for exhibition this evening: at a future time it is to be presented to the Franklin Institute, to be deposited in their model-room. This point is constructed of eighteen small copper wires, soldered to the upper end of an iron rod, the junction surrounded by a zinc ball, the object of which is to preserve the copper points from oxidation. This point was made over thirty years ago—as I find it described in Professor Hare's Chemistry—and, as may be seen by examination, the copper wires are in good order. I exhibit two points of my own construction, differing somewhat from Professor Hare's, but upon the same principle. One of these was placed upon a flag-pole upon the American Mechanics' Hall, and was struck by lightning last summer; one of the copper points shows slight marks of fusion, but not injured for further use; no other effects could be traced upon the rod or building. Here is another point which has been struck, a platina point, of M'Allister's manufacture; the platina is all melted off, and the rest of the points much torn by the explosion. This I have found to be the case in all instances with the platina point, doubtless owing to its very low conducting power and the form in which it is used. Another objection to this point is the very imperfect method of connecting the point to the rod. I consider the platina points of little value for lightning rods. Points should be so constructed as to be uninjured when repeatedly struck. In replying to the remarks of Professor Frazer, my opinion is, that although lightning conductors in complete order do silently convey electricity from a cloud, yet they cannot in this way prevent a stroke at all times; if they could, lightning should never strike in this city where there are many hundred rods, many of which are as complete as possible, and yet it does strike from three to six times or more every season. Again, whoever has watched the lightning's flash during storms, has observed it to pass horizontally a long distance—probably many miles—and then descend to the earth; in such cases, the clouds being too far off to be discharged silently by the conductor, it then becomes the office of the lightning rod to receive and convey the stroke harmlessly into the earth. In an instant it may pass from the clouds, say ten or fifteen miles distant, to one directly over us, and thence to the earth, destroying life and property without discrimination, unless protected by suitable conductors. A word or two relative to insulation of rods; no good authority sanctions their use. Professor Hare's rod, erected by himself, on the contrary, is soldered to the metal roof, making the roof a part of the conductor. This principle I have adopted on many large buildings in this city, such as railroad depôts, market-houses, Girard College buildings, &c."

THE SUBSTITUTE FOR GUTTA-PERCHA.—Our readers are aware that the Society of Arts recently awarded its gold medal to Sir William Holmes for his introduction of balata into British commerce. The history of this gum, or vegetable milk, points to Mr. Charles Hancock as the first to recognise its valuable properties, and to recommend its employment as a substitute for india-rubber and gutta-percha, as will be seen by the following letter of Sir William Holmes to P. Le Neve Foster, Esq. In this instance, as in others that have come under our notice, the wisest discrimination has not been exercised by the Society of Arts in its award:—"I was Commissioner, representing the colony of British Guiana, at the International Exhibition of 1862. Amongst the varied contributions from the colony was a morsel of the dried milk of the bullet-tree (*sapota mulleri*); it weighed, perhaps, half a pound. Amongst the numerous individuals who visited the Guiana department was Mr. Charles Hancock, who is well known in the gutta-percha trade. This gentleman was struck with the appearance of the specimen, and obtained a portion for experiment; he reported favourably as to its utility and value, a result most gratifying to me, as I had received adverse opinions from less experienced persons. This happened, I think, in July, 1862. From that time to the present I have been engaged in investigations how to produce the material cheaply, and how to dry or coagulate it rapidly. In both particulars I believe I have succeeded so far as to warrant the importation of steam machinery to be applied to its extraction, and by a fortunate accident I have discovered how to dry or coagulate it, preserving the characteristic of elasticity at a single operation by the addition of a simple ingredient not very costly. The samples forwarded consist of—1st, a bottle of milk, as extracted from the tree by tapping; 2nd, of lumps or cakes, weighing together five pounds, of this milk prepared for the market; and 3rd, some balls to show, by the result of the process discovered by me, that this material is nearly as elastic as india-rubber; indeed, as far as I can judge, balata cannot be rivalled by either that material or gutta-percha, possessing, as I before stated, much of the elasticity of the one and the ductility of the other, without the intractability of india-rubber or the brittleness and friability of gutta-percha. Amongst the useful properties possessed by balata, I believe the fresh milk of the bullet-tree to be the best waterproofing material yet discovered; and further, that balata, as prepared by me, will supply the great want of the day, as a good insulating medium for telegraphic purposes. The bullet-tree is a magnificent timber tree, often squaring thirty to forty inches, and is much used, especially in Berbice, for building purposes. The milk, when quite fresh, is so bland that it is sometimes used as a substitute for cow's milk, and the fruit is delicious. The bullet-tree abounds in many districts

of the colony—indeed, I may say throughout this part of South America; and I trust that balata may ere long be added as an important item to the exports of the colony, and tend to prove that the International Exhibition of 1862 has, in this instance also, been productive of practically useful results, not only to this community, but to the interests of science and art generally."

Nothing New under the Sun.—Great inventions do not spring into existence in a state of perfection, and hence there is some pertinence in the words of Solomon, "There is no new thing under the sun," in their frequent application by those disposed to detract from the merits of the ingenious men who have invented or perfected the most important elements of our modern civilization. The beginning of most inventions is very remote. The first idea born within some unknown brain passes thence into others, and at last comes forth complete, after a parturition it may be, of centuries. One starts the idea, another develops it, and so on progressively, until at last it is elaborated, and worked out in practice. It is not possible to measure the share of each in the merit of the invention, and apportion it duly, but mankind is most indebted to him who gives it vitality and practical utility. Sometimes a great original mind strikes upon some new vein of hidden power, and gives a powerful impulse to the inventive faculties of man, which lasts through generations. More frequently, however, inventions are not entirely new, but based upon contrivances previously known. Glancing back over the history of the useful arts, we occasionally see an invention seemingly full-born, when suddenly it drops out of sight, and we hear no more of it for centuries. It is taken up anew by some inventor, stimulated by the needs of his time, and falling again upon the track, he recovers the old footmarks, follows them up and completes the work. The history of the steam engine is now to a certain extent familiar to most reading men, and the progress of its invention can be traced at intervals through a period of over 2,200 years. An old German book, printed in the year 1577, speaks of the reaping machine as a worn-out invention which was wont to be used in France, and the description therein contained shows it to have been, at least, somewhat like the modern machines for the same purpose. Breech-loading cannon and firearms, made at least 300 years ago, and revolvers 200 years old, are now in existence. Anæsthetics were used by the ancient Egyptians. Something like the daguerreotype, printed by the light of the sun, was known to Leonardo da Vinci 400 years ago. The idea of propelling vessels by steam seems to have been experimented upon by Blasco de Garay, as early as the year 1543. The conception of the electric telegraph dates back over 200 years. The use of coal gas, for lighting purposes, was known to the Chinese many years before it was known in Europe and America, and something like the modern postage stamp is said to have been used in Paris in the year 1653. Yet, in view of these facts, no candid mind will refuse to acknowledge Watt as the inventor of the condensing steam-engine and the most important feature of the high-pressure engine, as we now know and use them, or grudge the honour due, and, by common consent accorded to Fulton, McCormick, Colt, Daguerre, Morse, Murdock, and other great inventors now living or but recently passed away, for their labours in developing and perfecting the machines, processes, and contrivances which have now become the very essentials of civilized life. He is most essentially the true inventor who gives practicability to ideas, whether they have originated in his own brain or in the minds of others.—*American Artizan.*

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2020. G. Bedson, improvements in "spinning" or twisting wire for fencing and other purposes.

2023. J. Dilkes and E. Turner, improvements in apparatus for facilitating communications between passengers, guards, and drivers, travelling by railway trains.

2029. S. Moore, improvements in electro-gilding.

2035. T. Morgan, improved means of communication in railway trains between passenger and guard, and guard and engine-driver, or otherwise.

2038. W. Milligan, an apparatus for communicating motion from one railway carriage to another, in a train applicable for signalling between passengers, guard, and driver, fastening and unfastening the carriage doors, working the breaks, and other purposes.

2045. T. Turner, improvements in communicating between one part of a railway train and another part thereof.

2047. T. P. Tregaskis, the improved use of magnets in overbalancing weights.

2049. W. Clark, improvements in apparatus for transmitting motion and power from one part of a railway train to another, for the purpose of effecting communication between the passengers and guard or otherwise, and for operating the breaks.—A communication.

1852. C. Cotton, improvements in railway carriages, to facilitate the communication of passengers from carriage to carriage of a railway train.

1853. W. Thomas, improvements in effecting communication between passengers and guard, and guard or other person in charge of railway trains.

2063. J. Thomsen, improvements in batteries for generating electricity, and in apparatus for converting the quantity thereof into intensity.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1820. W. Booth, an improved means or method of communication between the guards, passengers, and engine-drivers of railway trains, or other public conveyances to which the same may be applicable.

1868. W. Dicey, an improved means of communication between railway guards or other attendants and passengers in railway trains.

1906. E. Tattersall, improvements in effecting communications in railway trains between passengers and guards.

PATENTS SEALED.

1242. J. Hamilton, jun., improvements in electric telegraph posts.

1565. J. D. Adams, improvements in electrical communicators.—A communication.

PATENT WHICH HAS BECOME VOID.

1967. L. W. Voillier, improvements in machinery for doubling and twisting yarns and threads, and for manufacturing wire rope.—A communication.

NOTICES TO PROCEED.

893. J. H. Simpson, certain improvements in printing from type by electricity.

996. H. Wadkin, improvements in apparatus for working points and signals of railways.

1820. W. Booth, an improved means or method of communication between the guards, passengers, and engine-drivers of railway trains, or other public conveyances to which the same may be applicable.

1853. G. Lansdown, a method of providing a direct communication between any guard and any passenger in a railway train.

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

2069. S. Whitaker and R. A. Jones, improvements in operating upon railway signals, and in indicating their position by means of electricity. 20th August, 1861.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good .... 2/2 to 2/6 per lb.

INDIA RUBBER.

Para, first quality .... 1/8½ to 1/9 ,,
second ,, ... 1/5 to 1/6 ,,
third Negro-head .... 1/2½ ,,
Java and Penang .... 1/3 to 1/5 ,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	63 to 65 x. d.	—
Stock	Electric Telegraph . . .	100	102 to 106 x. d.	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	$1\frac{1}{4}$ to $\frac{3}{4}$	—
10	Mediterranean Extension Tel. .	all	3 to $3\frac{1}{2}$ x. d.	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{1}{2}$ dis. to $\frac{1}{4}$ pm.	$3\frac{7}{8}$-$\frac{1}{2}$

TO CORRESPONDENTS.

*** Owing to the great space occupied by one or two articles we are compelled to postpone the publication of several interesting communications until next week.

A Reader.—The form of battery proposed by you is by no means new.

J. P. M.—Binding covers are kept on hand. The expense of binding a single volume is 1s. 6d.

A Telegraphist.—The whole of the gentlemen employed have returned, with the exception of Mr. F. C. Webb, who will remain in the Gulf until the beginning of next year.

A Telegraph Clerk.—The office of the Institution is at 90, Cannon-street, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

Quarterly, 4*s.* 4*d.* | Half-yearly, 8*s.* 8*d.* | Yearly, 17*s.* 4*d.*

THE TELEGRAPHIC JOURNAL.

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ELECTRO-METALLURGY BY INDUCTION.

Last week, in speaking of experiments made with Mr. Thompson's induction machine, we stated that it was intended to make some experiments with it in electro-deposit or electro-plating. Since then a series of experiments has been begun, of which we can speak of one. In the ordinary electro-depositing generally one large vat is used, and battery cells of enormous size and few in number; therefore this deposit is by electricity of low intensity. If the resistance of the vat be not properly balanced with the intensity of the battery, the electro-deposit is irregular; either the metal is thrown down as (what is termed by electro-platers) metallic mud, or else the process lags and is almost brought to a standstill. The former takes place when the resistance is less than the power of the battery. The latter when it is more. In some cases even, if the metal is not thrown down in the shape of mud, it is deposited on the surface that has to receive it, in a rough and lumpy state; therefore great care has to be taken that too great a quantity of electricity is not sent through the depositing vat. Then care has to be taken that a pellicle of oxide does not spread over the positive plates and articles in the vat, or there will be too great a resistance and the deposit will stop. The plates and articles have frequently to be taken out and cleaned: otherwise if the oxide be left on the article the subsequent metallic deposit will peel off. These are all inconveniences incident to the practice of depositing by means of electricity of low intensity, and hitherto to use electricity of moderately high intensity required batteries of a considerable series of cells, which introduce a trouble of another kind: the trouble of keeping large batteries in order. With this machine this difficulty is overcome, but the procedure is somewhat different. Instead of a large vat a series of depositing cells is required. In this experiment fifty depositing cells were used; in each a surface of thirty inches was exposed. Besides these fifty cells the machine required to give it full work, an external resistance equal to the resistance of 20 miles of No. 8 iron wire, and the resistance of these 50 cells was under one mile of such wire; therefore the machine would have deposited in each of one thousand cells the same amount of metal as it deposited in each of the fifty. The quantity deposited in five hours in each cell was $3\frac{3}{4}$ grs., and thus for 1000 cells is 3750 grs., and for one day of ten hours 7500 grs., which is more than 1 lb. avoirdupois. And this deposit was in copper; in silver it would have been considerably more: the equivalent of silver being 108, while that of copper is only 31·7.

This process of electro-plating seems admirably adapted to the electro-plating of spoons and forks, and these are certainly articles wherein the greatest demand is.

From this experiment it appears that more than 200 dozen of spoons and forks could be electro-plated at once and in one day. Besides, no amount of oxide that can form on the positive plates prevents the flow of the electricity, and on the negative there was no oxide. The electro-deposit is perfectly steady and continuous throughout; there is no variation, so that if you ascertain how much is deposited in any one hour you will find the same deposited in any other hour; besides it is only necessary to ascertain what is deposited in one cell, for in each cell precisely the same quantity is deposited, neither less nor more, the same current of electricity passing through all.

This is only the beginning of a series of experiments. We hope by-and-by to be able to state more on this matter; for it would seem that induced electricity bids fair to take the place of voltaic.

THE ADVANTAGE OF OCEAN TELEGRAPHY.

The history of the first attempt to construct and submerge a deep sea line of telegraph between England and America, is a highly interesting one, and by no means devoid of instruction. However brief the triumph, it established a momentous fact, as eternal as the great Atlantic itself, that beneath its tempestuous billows there was laid once upon a time *a way for the "lightning of thunder."* However heavy the expenditure, the sacrifice, and the amount of dissipated hopes, the Atlantic cable was nevertheless the pioneer in whose gigantic stride others have followed, and will again follow, until success shall have crowned the noble and glorious effort.

As an illustration of some of the practical and important services which a system of ocean telegraphy is capable of rendering in cases of emergency, the following interesting statement, made in evidence before the Government Telegraph Committee, will serve to exemplify.

It is the evidence of Mr. Saward, the indefatigable Secretary of the Atlantic Company:—"During the Indian rebellion it had been expected that it would have been necessary to recall further troops into England, for the purpose of sending them to India; amongst others an order had been sent to Montreal and Halifax respectively, for the 32nd and 69th regiments to come home. The order was a written one. The state of affairs in India meanwhile took a more favourable turn, and the war department considered that it was no longer necessary that those troops should return; in consequence of which two messages were sent through the Atlantic Telegraph Company's cable, one to Montreal and one to Halifax, giving orders to the commanding officers at those places not to send home those regiments. In answer to the remaining part of your question (Mr. Varley's), as to the expense saved, of course it would involve the expense of ships to bring those troops home, and subsequently ships to return them to the same place again; the outlay for that purpose certainly could not be estimated at much less than £40,000 to £50,000." Mr. Newall, the eminent telegraph contractor, in his evidence, further exemplifies the benefit, by repeating a statement made to him by the late Lord Lyons, "that in his (Lord Lyons') opinion, the telegraph cable between Varna and Balaklava lessened the duration of the war by two or three months, by affording the means of rapid communication with the Crimea."

We have thus on record that in two cases of great emergency, ocean telegraphy was the means of saving the public a large amount of treasure, and tended materially to mitigate the horrors of a protracted and sanguinary war.

At the present time, when the United States of America are engaged in a fierce and bloody strife, and each day fraught with ominous consequence, not only to their own well-being, but also to our commercial and manufacturing interests, and our toiling millions, how deeply to be deplored is the silence of that once active and peaceful messenger, which, in the warmth of its first lisping efforts, proclaimed—"Europe and America are united by telegraph. Glory to God in the highest; on earth peace, good will towards man."

A comprehensive system of deep sea telegraphs would be a most valuable acquisition to the preventive and defensive institutions of the country. It should be laid so deep as not to allow of its destruction by an enemy, so as to enable our military and naval authorities at all times to concentrate their whole forces at a given point, and to regulate the operations of those forces as completely and effectually as if they were under their own eyes.

In the matter of diplomacy, the advantage of rapid communication between distant countries it would be difficult to overstate; and it would be idle to suppose that the commercial world will long neglect the power which ocean telegraphy is capable of conferring on the commercial interests of various countries, by establishing them in closer contiguity as regards commercial intelligence and transactions; seeing that by it may be made known in the remote marts of America, India, China, and even Australia, and *vice versâ*, all the fluctuations in the prices of marketable commodities, and every bargain in stock or shares within a few minutes of the transaction being closed in either place. Further, the facility for social intercourse between families and friends permanently or temporarily sojourning in distant lands, which the telegraph would afford, is a subject which evokes the heartiest wishes for its success.

ON THE DIRECT CORRELATION OF MECHANICAL AND CHEMICAL FORCES.

By Henry Clifton Sorby, F.R.S.

Perhaps it may be thought somewhat strange that a geologist should undertake such a subject as the correlation of forces, but the very fact of my being a geologist has led to the investigation of which I now purpose to give a short preliminary account. In studying general chemical and physical geology, and especially in examining the microscopical structure of rocks, I have for a number of years been greatly perplexed with a class of facts which pointed both to a mechanical and to a chemical origin. At first I attributed them either to a mechanical or a chemical action, or to the two combined; but, in most cases, no satisfactory explanation could be given. At length, however, facts turned up which altogether precluded any supposition not involving direct correlation; for they most clearly indicated that mechanical force had been resolved into chemical action in the same way as, under other circumstances, it may be resolved into heat, electricity, or any other modification of force, as so ably described by Grove, in his work "On the Correlation of Physical Forces."

The effect of pressure on the solubility of salts has already been made the subject of speculation and experiment, and a considerable number of facts have been described, showing that pressure will more or less influence such chemical actions as are accompanied by an evolution of gas, so that it may cause a compound to be permanent which otherwise would be decomposed; but the results were for the most part so indefinite and unconnected, or of such a character, that Mr. Grove does not allude to the direct production of chemical action from mechanical force. That this is, however, extremely probable will be evident to all who have considered the manner in which the various physical forces are correlated; for if mechanical force can be produced by chemical action, why should not the converse be true? In this paper I shall endeavour to show that such is really the fact, and that in some cases the mechanical equivalent of the chemical force may be determined.

In order to obtain the necessary great pressure, I have made use of a modification of the method employed by Bunsen, but, instead of filling the tubes at the ordinary temperature of the atmosphere and then gently heating them for several hours, I, in the first instance, filled them at a temperature of 10° or 20° C. lower, so that when finally sealed up they contained considerably more liquid that they could hold without pressure at the ordinary temperature of the atmosphere at the time being, and thus, by its tendency to expand, this liquid and anything enclosed in the tube, were subjected to a very great pressure. By keeping the tubes in various parts of the house, according as the weather varied, I have been able to maintain for several weeks or even months a pressure of, for instance, about 100 atmospheres, as measured by means of a capillary-tube pressure-guage enclosed within the larger tube. Since, in all cases, I had a second tube, which from first to last was treated precisely like the other, pressure excepted, I have been able to determine the effect produced by the pressure with very considerable accuracy, at all events so as to leave no doubt whatever about the general facts. At the same time I wish it to be understood that the results described below must be looked upon only as approximations to the truth.

I will first call attention to the well-known influence of pressure on the fusing-point of various substances, since it is a connecting link between well-established facts and those I am about to describe. Bunsen and Hopkins have shown that substances which expand when fused, have their point of fusion raised by mechanical pressure; that is to say, since mechanical force must be overcome in melting, the tendency to melt must be increased by heat before that opposition can be overcome; and the pressure required to keep them solid at any temperature above their natural point of fusion may be looked upon as the mechanical presentative of the force with which they tend to fuse at that temperature. Professor W. Thomson has shown that, on the contrary, water, which expands in freezing, has its point of fusion lowered by pressure; that is to say, since mechanical force must be overcome in crystallizing, crystallization will not take place under increased pressure, unless the force of crystalline polarity be increased by reducing the temperature. Thus, calculating from his experiments, and from the known latent heat of ice, and assuming that no heat is gained or lost by contact with external objects, if we had one part of ice and 100 of water at 0° C., and then applied a pressure of 103 atmospheres, the ice would, as it were, dissolve in the water, the whole would become liquid, and the temperature be reduced to —·792° C., or, in other terms, at that temperature the tendency to crystallize is exactly counterbalanced by that pressure.

Now I find that similar principles held true with respect to the solubility of salts in water. If, when they dissolve, the total bulk increases, pressure reduces their solubility; whereas, if the bulk decreases, pressure makes them more soluble; in other words, solution or crystallization is impeded by pressure according as mechanical force must be overcome in dissolving or in crystallizing.

Various authors have written on the volume with which salts enter into solution; but since the subject before us requires a different class of facts to be taken into account, I shall base my conclusions on my own experiments. The volume with which salts exist when in solution, assuming that of the water to remain unchanged, varies greatly in the case of different salts, and also according to the amount in solution and the temperature. Thus, taking sal-ammoniac as an example, when there are 3 per cent. in solution in the volume is as if it expanded 3·40 per cent. on dissolving; whereas, when 25·55 per cent. are in solution, the expansion is 11·36 per cent., and when nearly concentrated at about 13° C., an additional quantity expands on dissolving 15·78 per cent. In by far the greater number of cases, however, there is a contraction on dissolving, and the amount gradually diminishes for each additional quantity entering into solution, so that the mean result is very different from what occurs when the solution is dilute or nearly saturated. It is this contraction or expansion when a small additional quantity is dissolved in a nearly concentrated solution that must be taken into account in the following calculations.

In determining the influence of pressure on the solution of salts, I found it requisite to adopt somewhat different methods according to the peculiarities of the salts. In some cases I sealed up in a saturated solution portions of the salt in clean solid crystals, and determined the effect due to pressure from their loss in weight; whereas in other cases I sealed up solutions containing more salt than could be dissolved at the temperature at which the experiments were made, and determined the effect of pressure from the difference in the weight of the crystals deposited, being of course careful to make allowance for any difference in the amount of solution in the tube with pressure and in that without, and to avoid any error that might be produced by a different temperature. In all cases I have had a tube with pressure and another without, treated from first to last in precisely the same manner, and kept exactly the same temperature, so that pressure was the only difference; and usually the effect was so well marked that there was no doubt about the result. In the case of chloride of sodium, solution goes on so slowly, and the mechanical equivalent of the force of crystallization is so great, that if pressure had been applied for only a few hours one might have concluded, with Bunsen, that pressure had no influence on solubility; but by maintaining it for a week or more, there was no difficulty whatever in perceiving that a solution which was quite

saturated without pressure dissolved more under a pressure of about 100 atmospheres.

The solubility of a salt in water appears to me to result from a kind of affinity which decreases in force as the amount of salt in solution increases. This affinity is opposed by the crystalline polarity of the salt; and when the two forces are equal, the solution is exactly saturated. As is well known, a change in temperature alters this equilibrium; and, according to my experiments, mechanical pressure relatively increases one or other of these opposing forces, according to the mechanical relations of the salt in dissolving. At all events, in the case of chloride of sodium the extra quantity dissolved under pressure varies directly with it for such pressures as glass tubes will resist, in the same manner as, according to Thomson's experiments, the fusing-point of ice is reduced. Thus I found that for a pressure of 49½ atmospheres the extra solubility was ·176 per cent., and for 121 atmospheres ·431, which are almost exactly in the same ratio. Hence, if s be the amount soluble without pressure, under a pressure of p atmospheres, the solubility at the same temperature would be $s + ps$, where the values of s and s are independent, and vary for different temperatures and different salts. Future experiments may perhaps show that this conclusion should be modified; but yet it will be well to adopt it provisionally, in order to compare together the mechanical relations of different salts which otherwise would not be so intelligible.

According to Michel and Krafft, and to Schiff, sal-ammoniac is the only salt known for certain to occupy more space in solution than when crystallized. Hence, under pressure mechanical force must be overcome in dissolving, and experiment shows that, on this account, the relative force of crystalline polarity is increased and the solubility decreased. This is the reverse of what results from an elevation of the temperature, so that the effect cannot be due to heat generated by the pressure, but must be the direct consequent of pressure. Calculating from an experiment where the pressure was 164 atmospheres, which gave a decreased solubility of 1·045 per cent. of the whole salt in solution, a pressure of 100 atmospheres would cause ·637 per cent. less to be dissolved than is soluble at 20° C. without pressure, and the pressure requisite to reduce the solubility to the extent of 1 per cent. would be 157 atmospheres. Expressing this fact in other words, we may say that a pressure of 157 atmospheres is the mechanical force with which the salt tends to dissolve in a solution containing 1 per cent. less than can dissolve at the same temperature without pressure, because the two forces exactly counterbalance one another. In a still more dilute solution the force would of course be still greater, in accordance with the fact of a greater pressure being necessary to prevent the salt from being dissolved. Supposing, then, that we had a solution a trifle more dilute than that just named, and in such indefinitely large quantity that a cubic inch of the salt could dissolve in it, and yet produce no sensible change in its strength, so that from first to last it might be considered to dissolve under a pressure of 157 atmospheres; and also, supposing that it was rigidly enclosed on all sides but one, so that the whole expansion must take place in one direction over an area of one square inch, since on dissolving there is an increase in bulk from 100 to 115·78, the solution of this cubic inch would, as it were, raise 2,355 lbs. through the space of ·1578 inch. This is mechanically the same as 371½ lbs. raised 1 foot, or, the specific gravity of the salt being 1·53, the same as 171 times the weight of the salt itself raised 1 metre. Since it involves no arbitrary unit but the metre, I shall adopt the last expression as the measure of the total amount of mechanical work done by the solution of salts which expand in dissolving, and which may conversely be looked upon as the measure of the mechanical force rendered latent, and, as it were, expanded in the act of crystallization when crystals are deposited. The value of this mechanical equivalent of course varies with the strength of the solution, as already remarked.

In the case of salts which occupy less space when dissolved than when solid, pressure, like the increased temperature, causes them to be more soluble; mechanical force is lost when they dissolve, and is, as it were, expended in giving rise to solution. When water thus containing more of a salt than could otherwise be dissolved at the same temperature is just saturated under any given pressure, the amount of pressure represents the force of crystalline polarity tending to cause the salt to be deposited in a crystalline form, but which is exactly counterbalanced by that pressure. I will not give the details for each salt, but subjoin a table of the results at which I have arrived for such as illustrate particular points of interest, the calculations being all made in accordance with the principles already described. I also give them in the case of water, calculated from Thomson's experiments, assuming that, when ice meets and mixes with water, it may be looked upon as dissolving in it; and, as will be seen, the mechanical force thus deduced is of the same general order of magnitude as that generated by the crystallization of salts:—

	I.	II.	III.	IV.	V.
1. Chloride of sodium	13·57	97	·407	·419	157
2. Sulphate of copper	4·83	60	1·910	8·183	7
3. Ferridcyanide of potassium. . .	2·51	86	·288	·335	42
4. Sulphate of potash	31·21	63	1·840	2·914	42
5. Ferrocyanide of potassium . . .	8·90	66	1·640	2·485	20
6. Water	8·93	—	—	·991	106

Nos. 2 and 5 are calculated as hydrated crystals.

Column I. gives the expansion of each salt in crystallizing from a nearly saturated solution of water, the volume in a crystalline state being taken at 100.

Column II. gives the actual pressure in atmospheres in the experiment.

Column III. gives the increased solubility due to the pressure given in column II., the total amount of salt dissolved without pressure being taken at 100.

Column IV. gives the increase in solubility that would be produced by a pressure of 100 atmospheres, as calculated in accordance with the principles already described, the same unit being taken as in column III.

Column V. gives the value of the mechanical work that could be done, or, so to speak, the amount of mechanical force set free when the various substances crystallized from a solution containing one per cent. more than would be dissolved without pressure, as measured by the number of times its own weight which any unit of the various salts could rise to the height of one metre in the act of crystallization. Conversely, it is the amount of mechanical force which becomes latent in the act of solution; and in the case of a still more supersaturated solution it would be greater, and *vice versâ*, in accordance with the fact of the increased solubility varying with the pressure.

On comparing together the various salts it will be seen that their properties vary very considerably. Thus, under the same pressure, the extra quantity of sulphate of copper dissolved is nearly ten times that of ferridcyanide of potassium. The mechanical equivalents also vary even more, being (for chloride of sodium) about 22½ times as great as for sulphate of copper. On the contrary, the mechanical equivalents of ferridcyanide of potassium and sulphate of potash are the same; but, under equal pressures, the extra quantity of the latter dissolved is nearly nine times as great, owing to the difference in the amount of expansion in crystallizing. This latter is, however, nearly the same for water and ferrocyanide of potassium, whilst, under the same pressure, the extra quantity of that salt dissolved is 2½ times that of ice, in consequence of the much greater mechanical equivalent of the ice. It appears to me that we may provisionally conclude that the increased solubility due to pressure varies directly with the change of volume, and inversely with the mechanical equivalent of the force of crystalline polarity, so that, if s be the total amount of salt which dissolves without pressure, c be some function of the change in volume in dissolving, and m some function of the mechanical equivalent of the force of crystalline polarity, the solubility, at the same temperature, under a pressure of p atmospheres, would be $+ s\frac{p.c}{m}$. If the salt be one that expands on dissolving, c of course is negative, and therefore under pressure the solubility becomes $s - \frac{p.c}{m}$; that is to say, it is diminished, as proved by experiment with sal-ammoniac. If no change in volume took place, we may, I think, also conclude that pressure would not in any way increase or decrease the solubility of salt. Moreover, since, when a solution is just saturated, the force with which the salt tends to crystallize is equal to that with which it tends to dissolve, their mechanical equivalents must be equal and opposite. Hence we may perhaps conclude that, other circumstances being the same, the mechanical equivalent of a salt like chloride of sodium, which so readily attracts moisture, would be greater than that of one like sulphate of copper, which so readily loses even its water of crystallization; and thus also the relative influence of equal amounts of pressure would be very different, as is confirmed by experiment in the case of these and some other salts.

The facts I have described, therefore, show that there is a direct correlation between mechanical force and the forces of crystallization and solution. According to some chemists, the latter is an instance of real combination; but, whatever views be entertained respecting its nature, we cannot, I think, deny that the force represents some modification of chemical affinity, or is at all events most closely allied to it. In comparison with some kinds of affinity it may indeed be, and probably is, weak; but yet, as I have shown, it sometimes has a very considerable mechanical equivalent, even when nearly counterbalanced by an opposite force; and since such pressures as glass tubes will resist have no very great influence on what we may perhaps consider a weak affinity, we cannot expect that any pressure at our command would have much influence on strong affinities. I have, however, succeeded in obtaining some results which apparently show that pressure influences undoubtedly chemical changes taking place slowly, and therefore probably due to weak, or nearly counterbalanced affinities.

The method adopted in this part of the inquiry was to seal up some solid substance in a solution which gives rise to a slow double decomposition, taking great care to have in the tube with pressure, and in that without, pieces cut so as to be of the same size and form, and a solution of the same character, so that, with the exception of pressure, all the conditions were the same. Possibly I may be so fortunate as to discover some case where the affinity is so weak that pressure may determine whether it go forward or not, of which fact the structure of metamorphic rocks furnishes examples; but hitherto I have only been able to prove that pressure modifies the *rate* at which chemical action takes place. This branch of the inquiry is, however, beset with many difficulties, for the change in volume produced by double decomposition is small, and its determination involves several complicated questions. The volumes of the solids is easily determined, but that of the salts in solution is not the same when other salts are present as when they are dissolved in pure water, and varies much according to the strength of the solution and the nature of the salts; and many points are still so obscure that I shall only give two cases by way of example.

When a portion of Witherite is enclosed in a tube with a strong solution of protochloride of iron, there is a slow decomposition into chloride of barium, which is dissolved, and carbonate of iron, which remains firmly attached to the Witherite, and would ultimately give rise to an excellent pseudomorph. The best conclusion at which I have been able to arrive is, that there is in the change an increase in volume equal to about 10·7 per cent. of the Witherite altered, so that, under pressure, mechanical force must be overcome. In an experiment where everything went on in a very satisfactory manner, the pressure was maintained for three months at from 80 to 100 atmospheres, and for one month was under 80 atmospheres, so that, on an average, it was about 80 atmospheres; and I found that the amount of chemical change was 21·7 per cent. less than when, all other circumstances having been the same, there had been no pressure; thus clearly showing that pressure had, as it were, diminished the force of chemical affinity. If then one cubic inch had been altered under this pressure, it would have overcome a mechanical force equal to that required to raise 1,200 lbs. through the space of ·107 inch, which is equivalent to raising twenty-one times its weight to the height of one metre; and under the same circumstances 1·278 cubic inch would have been altered when no such mechanical force had to be overcome. Supposing, then, that in both cases the total energy at work was the same, but in one was altogether expended in producing a chemical result, and in the other in producing partly a chemical and partly a mechanical effect, we may say that the force which gives rise to the purely chemical change, taking place at a particular rate, is equal to that which gives rise to this chemical effect, taking place at ·783 of that rate, and to a mechanical effect equal to the force required to raise in the same space of time 34·87 times the weight of the Witherite altered to the height of one metre. Supposing, also, that the power of chemical force varies at the rate at which it gives rise to a chemical change, in the same manner as the power of a mechanical force varies as the velocity of motion imparted by it, we may perhaps conclude that this mechanical force is equal to ·217 of the chemical force, and that the whole energy of the chemical action under the conditions of the experiment was equal to the mechanical power required to raise, in the same period of time, 160 times the weight of the Witherite altered to the weight of one metre. If these principles are correct, a pressure of more than 370 atmospheres would have entirely counterbalanced the force of chemical affinity, since to produce any chemical change it would then have had to overcome a greater force than it possessed. This is so great a pressure that I fear it will be difficult to prove the deduction by experiment; and until some such case can be found, capable of being verified, these calculations must be considered as little more than suggestions, which future investigations may confirm or disprove.

When calcite is sealed up in a mixed and rather strong solution of chloride of sodium and sulphate of copper, slow double decomposition gives rise to malachite, sulphate of lime, and carbonic acid; and though this is extremely complicated, and it is very difficult to determine what would be the change in volume, yet, so far as I am able to make out, until the solution becomes saturated with sulphate of lime, there is a decrease in volume equal to about 8 per cent. of that of the calcite altered, so that, under pressure, mechanical force is the very reverse of being opposed to the chemical change. Three experiments all indicate the same fact, and in which, on an average, the pressure was about ninety atmospheres for two weeks, show that, as a mean of the whole, the amount of chemical change of 17 per cent. more with the pressure than without; thus proving that pressure had, as it were, increased the force of chemical affinity. Calculating according to the principles described above, we may conclude that a pressure of 530 atmospheres would have caused the action to take place at double the rate, and that therefore the chemical action is equivalent to the expenditure of that amount of mechanical force, being thus generated by it. Arguing then in a manner similar to that already described, but modified to suit the different conditions, if there be a contraction equal to 8 per cent. of the bulk of the calcite, there must be a loss of mechanical force capable of raising twenty-eight times the weight of the calcite altered to the height of one metre, in the time required for the chemical change; which amount of mechanical energy, as it were, becomes latent, and is transformed into chemical action, and would again exhibit itself as a mechanical force if, by any means, the chemical affinities could be inverted, and everything restored to its original state.

In like manner, other experiments indicate that in some cases pressure causes a slower, and in others a quicker chemical action, whilst in others it has scarcely any influence whatever; and though, for reasons already explained, I say it with some hesitation, yet, bearing in mind what is already known respecting the action of pressure on hydrate of chlorine, hydrated hydrosulphuric acid, and other substances described by various authors, I think the facts I have described make it very probable that further research will show that pressure weakens or strengthens chemical affinity according as it acts against or in favour of the change in volume; as if chemical action were directly convertible into mechanical force, or mechanical force into chemical action, in definite equivalents, according to well-defined general laws, without its being necessary that they should be connected by means of heat or electricity. On the present occasion I shall not attempt to consider the various geological and mineralogical facts which appear to me to admit of the application of the principles I have described, for many of them are peculiarities in structure of which neither myself nor any one else has ever given a description, and would therefore demand a preliminary notice. However, I may say that it appears to me that a number of facts connected with metamorphic rocks and the phenomena of slaty cleavage, which, to me at all events, have hitherto been inexplicable, are readily explained if mechanical force be directly correlated to chemical action, and if in some cases the direction in which crystals are formed be more or less related to pressure, in some such way as there is a connection between their structure and the magnetic force shown by the experiments of Plücker, Faraday, Tyndall, and many other observers. We may also, I think, explain the origin of the impressions on the limestone pebbles in the "Nagelflue" in Switzerland, about which so much has been written in Germany and France, without a satisfactory reason having been discovered; and the same explanation accounts for the mutual penetration of the fragments of which some limestones are formed, and for the banded structure of some which possess slaty cleavage. The curious teeth-like projections with which one bed of limestone sometimes enters into another, also to a certain extent indicate a chemical action depending on mechanical force; and probably the same may be said of some of the peculiarities of slickensides and mineral veins. It is also possible that a pressure of several hundred atmospheres may facilitate some of the chemical changes involved in the transformation of water and carbonic acid into the organic compounds met with in animals and plants of low organization found at great depths in the ocean, and thus to a certain extent compensate for diminished light. I, however, most

willingly admit that very much remains to be learnt before we can say to what extent the principles I have described are applicable; and yet, at the same time, cannot but think that henceforth they must be taken into account in many departments of the chemical and physical geology, and will readily explain a number of facts which otherwise would be very obscure.

ADMIRAL FITZROY ON CHARTS, CURRENTS, &c.

FROM our synoptic charts, and other accumulated reasons, I now feel sure that the simply *mechanical* action of two (or more) air currents are the *immediate* causes of all our atmospheric motions, and that the antagonism of heat and cold occasion those currents—without electric *origination*—the development of electricity being *consequences* of the atmospheric *action*, excited by *cold* and *heat* (space and sun).

Incessantly as the earth turns, atmospheric currents are moved, and their normals are modified by circumstances, often varying. Oceans, mountains, deserts, forests, even rivers affect the winds in their course, progress, and nature.

Constant progression *toward* the west, in the intertropic zone, *must force* as incessant a movement of return towards the east, over, between, or under the perennial westward draught,—to equilibrate the fluid atmosphere, which is an almost generally concentric expanse of air—elastic, gaseous, infinitely mobile, chemically homogeneous, and *sensibly* not much exceeding ten or twelve miles in *depth*.

Each of the air currents acquires momentum, and each has obstacles in its progress. The effects of obstacles are not confined to their locality, but are carried elsewhere by the general movement.

Similarly, but on a merely microscopic scale, effects of rocks, piers, shoals, and vessels, are seen in a river, or tideway, where eddies, swells, lines of broken water, ripplings, or discoloration, are traceable to long distances from their causes.

All the variations and apparent anomalies of air currents, or winds, are remarkably like (though vastly more extensive and complicated, on account of elasticity, &c.), and, indeed, may be roughly illustrated, in explanation, by oceanic and fluvial movements.

In the temperate zone the chief currents of air run against, and over or under each other—one follows the retreat of its opponent, or presses onward (direct or deflected), as the other runs in a nearly opposite direction, at the same level.

When this last condition occurs horizontal eddies are caused, travelling between the juxta-pressing breadths of air (hundreds of miles in extent, possibly much more, often far less; but always very broad in proportion to depth) and carried along by them, for a very few days, or only hours. These cyclonic effects are near the principal points of meeting, or *nodes* of the main currents.

As one current fails, becomes less in velocity, quantity, or momentum, another increases; but not *immediately*. Time must elapse to admit of changed impulse, altering old and exciting new movements, in any direction. Once effected the result is seen in a flow (or wind) from the one place (that of most pressure or highest tension) toward the other, until a balance is restored.

Another remarkable and interesting mode of aerial action is when the main currents are so equably impelled and co-extensive that their antagonism is felt through many degrees of longitude at *nearly the same time*, and unusual commotion, with many combinations, result over an extensive area: some effects being like those described, others cyclonic; the whole, however, being carried *eastward* bodily, in accordance with the normal circulation of the atmosphere in temperate zones.

Lay a line (or rule) across a map of Europe, from Cape Clear to Toulon—it will lie N.W. and S.E., nearly (true). Imagine a parallel line extended each way from Cape Finisterre, and let this be supposed to represent the *average* advancing front of a S.W. wind, which, as it moves toward the N.E. (*over*, between, or here and there, even under the air *already* impelled along the surface toward the S.W.) *also* sides eastward? The resulting effects seem to be more rapid advance in *some places* than in others, through a space some 20 or 30 degrees wide, and a consequent protrusion of stream-like quantities into, or over, or under the polar current, considerably before the *whole front* has arrived. Such streams, opposed by polar air, recoil, or turn, or eddy—hence squalls, or even cyclones.

When a cyclone is thus caused, *or* by an actual lateral action of main bodies of air, it does not lose its impetus and momentum suddenly; but travels on between the parent bodies, impelled *more* northward *or even southward* of east—*according* as *either current* is the gaining, or advancing body—along earth's surface.

On the 1st, 2nd, 3rd and 5th of December, 1863, there were advancing bodies of air—each in great volume, and though their effects were very various—several characteristics were distinctly traceable. Owing to the *general* advance of one from north-east simultaneously with the other volume, or impulsion, from south-west—effects of a *similar nature* were felt all across southern and part of northern mid-Europe, say Ireland, Great Britain, Holland, Denmark, Germany, France, and Northern Italy.

But these effects were not due to *one travelling* cyclone—(monstrum horrendum!) they were results of two great atmospheric impulses—*seemingly*, not *truly* waves, but rather, as it were, pulsations from opposite directions, breasting each other in mutual opposition! When two such impulsions, however termed, are opposed to each other, or checked by any obstacle, they must swell or rise (if possible) or increase in *tension*. Their tendency (if unconfined) is to break against any impediment to their movements, and the results are horizontal currents. If the encounter is slow and *gradual*, vertical rise alone takes place, with increase of tension, checking any currents along the surface of earth. Of course currents already in motion act against each other similarly, with proportionate effect.

All our approaching south-westers appear to have a wave-like appulse—*aligning* from Cape Clear or Valentia, by Penzance, to Brest, and *further*, nearly at the same time. Now, if such an alignment crossing Finisterre—advances parallel to itself—it will touch Rochefort nearly with Valentia, and, allowing for *resistance* with some deflection by *land*, it may touch Marseilles, Toulon, &c., soon after—long before any cyclone could travel there *from* the *north-west*.

Complicated and difficult as the comprehension of all bearings of such cases of atmospheric commotion undoubtedly are, we must not be deterred from prosecuting them, or discouraged by quasi-uninformed men (on *these* subjects) saying, 'Meteorology is a mystery impossible to clear, and unsuitable for practical purposes." Dynamics—a careful observation of the movements of fluids in general, a full allowance for expansion of air, for its *resilience*, and when cooled for its *contraction*, for *deposit* of fog, dew, rain, hail, or snow, for heat, latent or otherwise, and for chemical changes, will gradually aid in developing all atmospheric questions.

While the principal currents are impelled against each other, or one over the other, atmospheric pressure (or tension) is augmented; and if equality continue, with gradual action alone, the result is a calm, with fine weather; but the contrary state or inequality—failure of one force—is directly followed by motion and its immediate results.

Among these *results* I now venture to place electric action—"*heat, a mode of motion*."

Electricity produced or excited in *common air*, even in a room, causes drops of water to fall, or will make a breeze.

Electricity is developed by the *frictional* action of *steam*—even *gas!* as shown at various institutions—especially the Polytechnic.

THE RAILWAY TELEGRAPH AT FAULT.

WE have been taken to task by more than one provincial paper for questioning the infallibility of the communication by electric telegraph on railways. We are admonished that Colonel Yolland's reliance is not misplaced, for that mistakes are quite unknown. We have cited one undeniable instance of fatal error, and we have not a doubt that many others occur which pass unnoticed because unattended with disaster. But only a few days ago there appeared in the *Times* an account of an accident caused by a mistake either in the wording or the understanding of a telegraphic message, with a reference to another error of the same class attended with fatal consequences:—

"An accident happened on the Shrewsbury and Hereford Railway a few days since, particulars of which have hitherto not been made public through the newspapers. It appears that some new rails were being laid down on a portion of the road between Ludlow and Shrewsbury, and here, the metals not being made quite tight, when a goods train came up it ran off the rails, obstructing the line. In consequence a passenger train which followed had to turn off the proper line at this point, and continue its journey on the other line of rails. Warning of its approach was signalled along the line, but from some mistake in the telegraphic despatch it was misunderstood, and the train on the wrong line had not proceeded

far when it met another train. The driver shut off steam, but a collision was unavoidable. Both drivers jumped off their engines, and escaped with a few bruises, but one of the stokers was much hurt, and both lines were obstructed for a considerable time. The up-mail train was hindered two hours. It will be remembered that a similar accident to this happened on the South Wales Railway between Pyle and Port Talbot three or four years ago, when, owing to an obstruction on the line by the breaking down of a cattle train, a passenger train was sent along the wrong line of rails, and met a second passenger train, two persons being killed and several persons seriously injured. In this case the telegraph had been used, and the line was supposed to be kept clear between Pyle and Port Talbot for the down train to proceed on the wrong line of rails. The message, however, was misunderstood, and the telegraph clerk was afterwards tried for manslaughter and sentenced to imprisonment."

Surely these, and many other instances that could be adduced, are enough to prove the fallibility of the telegraph for warning of danger on railways. And the liability to error is not confined to the clerk who sends the message, but extends to the servant who receives it, and conveys it to the signalman, with whom there lies a third chance of mistake. This is not a reason for not using the telegraph, but for not putting implicit trust in it. Let it be regarded as highly serviceable, but not infallible, and it will be conducive to safety and convenience without risk.

The greater the reliance on signals the greater is the danger of the public. It is relying on signals that railway managers despatch trains in the rapid succession which has caused so many collisions attended with destruction of life and terrible injuries. And every fancied improvement in signalling encourages the imprudence.—*Examiner.*

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

VI.

A.D. 1785.—M. Haüy, in 1785, knew the electric properties of calamine and of sphene, as developed by heat. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 133, 134.)

A.D. 1786.—Mr. Bennet, in 1786, by his electroscope, discovered the electricity developed by sifting powders. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 122.)

A.D. 1787.—Mr. Bennet, in 1787, first noticed that electricity was developed during the separation of the particles of bodies. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 138.)

A.D. 1787.—M. Haüy, in 1787, made the following discoveries:—That electricity is developed by heat in the minerals *mesotype* and *prehnite;* and that Iceland spar and some other crystals become electric by pressure. He also established many of the laws of pyro-electricity. (See Haüy's *Minéralogie*, Vol. II., p. 604; also *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 132, 133, and 138, 139.)

A.D. 1787.—Mr. Brard, about 1787, remarked that some crystals of axinite become electric by heat. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 132.)

A.D. 1787.—Lomond, in 1787, in an electric telegraph, employed one wire and a pith-ball electrometer. (See Highton's *Electric Telegraph*, pp. 38 and 41.)

A.D. 1787.—Betancourt, in 1787, used a telegraphic arrangement of one line wire and a battery of Leyden jars. (See Highton's *Electric Telegraph*, p. 38, and 41, 42.)

A.D. 1788.—Cavallo, about 1788, made known his condenser and other similar improvements. Other "condensers," "multipliers," and "doublers," were invented about this period. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, p. 91.)

A.D. 1788.—The Abbé Barthelémy "is said to have suggested an electric telegraph in his well-known work 'Voyage du Jeune Anacharsis," which appeared in 1788." This fanciful idea is as follows:—Two clocks were to have similarly magnetized hands; artificial magnets were presumed to be so far improved that they could convey their directive power to a distance; thus, by the sympathetic movements of the hands or needles in connection with a dial alphabet, communications between distant friends could be carried on. (See Mr. Macgregor's letter in the *Society of Arts Journal*, May 20, 1859, pp. 472, 473.)

A.D. 1790.—MM. Fourcroy, Vanquelin, and Seguin's grand experiment of the composition of water from its constituent gases was commenced on May 13, 1790, and continued without intermission until its finish on the 22nd of the same month. The gases were fired in a close vessel by means of electricity, and produced a nearly equal weight of water. (See Ure's *Dictionary of Chemistry;* also Noad's *Lectures on Chemistry*, p. 183, 184.)

A.D. 1790.—Paetz and Van Troostwik, in 1790, decomposed water into its constituent gases by passing the electric spark through it, very fine gold wires being used as electrodes. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 443.)

A.D. 1791.—Haüy, in 1791, discovered the electrical properties developed in borate of magnesia (boracite) by heat. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 131, 132.)

A.D. 1791.—Galvani, in 1791, found that the limbs of a frog were convulsed when his pupil touched them with a dissecting-knife at the same time that a spark was drawn from the prime conductor of an electrical machine. He afterwards found that similar convulsions were produced by establishing a communication between the nerves and muscles by means of metals; thus laying the foundation from which the galvanic battery afterwards sprung, also of the science of animal electricity. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 220; also Bakewell's *Electric Science*, pp. 27-29; also De la Rive's *Treatise on Electricity*, Vol I., pp. 29, 30, Vol. II., pp. 483 and 488, 489, and Vol. III., pp. 3-6.)

A.D. 1791.—Keir, in 1791, knew that iron and other metals could be made "passive" or electro-negative, so as not to be soluble in acids. (See Gmelin's *Handbook of Chemistry*, Vol. I., p. 353.)

A.D. 1793.—Dr. Fowler, in 1793, made a great number of experiments on the effects of galvanism in different animals, and on different parts of animals. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 220.)

A.D. 1793.—Volta, in 1793, in a letter to Cavallo, laid the foundation of the contact theory of galvanism. (See *Philosophical Transactions*, 1793; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 220.)

A.D. 1794.—Reizen, in 1794, had an electric telegraph of 26 line wires; the letters of the alphabet were cut out in pieces of tinfoil, and rendered visible by sparks of electricity. (See Highton's *Electric Telegraph*, pp. 38 and 42, 43.)

A.D. 1795.—Cavallo, in 1795, used an electric telegraph with one wire; the number of sparks was made to designate the various signals, and the explosion of gas was used for an alarum. (See Cavallo's *Traité de Télégraphie Electrique*, 4th edition, Vol. III., p. 285; also Abbe Moigno's *Traité de Télégraphie Electrique*, p. 61; also Highton's *Electric Telegraph*, pp. 38 and 43.)

A.D. 1795.—Dr. Wells, in 1795, found that charcoal may be employed to excite the galvanic influence, and that it is a conductor of that influence. He supposed galvanism and electricity to be identical. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 220, 221.)

A.D. 1796.—Salva, in 1796, invented an electric telegraph, the exact particulars of which are unknown. (See Highton's *Electric Telegraph*, pp. 38 and 43, 44.)

A.D. 1796.—Adini, about 1796, produced, by galvanism, powerful muscular contractions upon the head of an ox recently killed. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 489.)

A.D. 1797.—Nicholson's spinning condenser was made known in "Nicholson's Journal" of April, 1797. Hooks connected to tinfoil mounted suitably on glass planes, one of which revolves while the other is quiescent, conduct the charges successively derived from the electrified body to electroscopic balls; a rotation given by the finger and thumb thus enables an exceedingly small charge of electricity to be detected and examined. By means of this instrument, Messrs. Nicholson and Carlisle ascertained the nature of the electricity of the ends of the composite galvanic battery. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 90, 91, and art. Galvanism, p. 177.)

A.D. 1799.—Fabroni, in 1799, "enters into an inquiry whether the phenomena of galvanism may not originate from the action of chemical affinities, of which electricity may be one of the concomitant effects." (See *Journal de Physique*, xlix, 348; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 215, 216.)

A.D. 1800.—Volta, on the 20th of March, 1800, "addressed a letter to Sir Joseph Banks, then President of the Royal Society, in which he announced to him the discovery of 'the voltaic pile;'" this letter was read before the Royal Society on June 26, 1800; the arrangement used consisted of discs of silver, zinc, and moistened card, placed in series. "La Couronne de Tasses" was afterwards invented by Volta; this arrangement consisted of a circle of cups,

each cup containing solution of salt, silver, and zinc, thus forming a perfect voltaic or galvanic battery. (See Bakewell's *Electric Science*, pp. 29, 30; also Highton's *Electric Telegraph*, p. 13.)

A.D. 1800.—Messrs. Nicholson and Carlisle, on the 2nd of May, 1800, decomposed water by the voltaic pile. They constructed a voltaic pile by means of the particulars given in the first four pages of Volta's letter, Sir Joseph Banks having, at the end of April, shown this part of the communication to Sir Anthony (then Mr.) Carlisle. (See Highton's *Electric Telegraph*, pp. 27-29.)

A.D. 1800.—Mr. Cruickshank, in 1800, arranged metallic plates and a liquid according to the principle of Volta's pile, but horizontally in a trough instead of vertically, the plates themselves forming the cells. He also changed the colour of litmus paper by the galvanic current. (See Highton's *Electric Telegraph*, pp. 13, 14, and 29.)

A.D. 1800.—Dr. Henry, of Manchester, about the year 1800, by the galvanic battery, decomposed the nitric and sulphuric acids and resolved ammonia into its elementary constituents. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 221, and art. Chemistry, p. 611.)

A.D. 1801.—Dr. Wollaston, in 1801, used ordinary frictional electricity to decompose water by means of his guarded poles. These poles were made by fusing the end of a capillary tube round a gold wire, and grinding the tube down gradually until the least possible portion of the wire was exposed; he was thus able to transmit the power of the electrical machine as a continuous current. (See De la Rive's *Treatise on Electricity*, pp. 444, 445.)

A.D. 1801.—Dr. Wollaston, in 1801, "decidedly pronounced that the oxidation of the metal in the pile is the primary cause of its electrical effects." (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 216.)

A.D. 1801.—Gerboin, in 1801, pointed out certain movements of mercury in an inverted syphon, beneath the positive pole of a galvanic battery, the said pole being immersed in an electrolytic solution, which covers the surface of the mercury, and the other pole of the battery being connected to the mercury in the other leg of the syphon. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 433.)

A.D. 1802.—A contributor to the Monthly Magazine for April, 1802, says that "Galvanism is at present a subject of occupation of all the German philosophers and chemists. At Vienna an important discovery has been announced—an *artificial magnet*, employed instead of Volta's pile, decomposes water equally well as that pile or the electrical machine, whence it has been concluded that the *electric*, *galvanic*, and *magnetic* fluids are the same." This announcement is of interest in respect to magneto-electricity. (See Bakewell's *Electric Science*, p. 40.)

A.D. 1803.—Trommsdorff, about the year 1803, discovered the efficacy of large plates, in galvanic batteries, in producing combustion of thin metallic leaves. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 221.)

A.D. 1803.—Hisinger and Berzelius, in 1803, "ascertained, by a numerous series of experiments, the transfer of the elements of water and of neutral salts to the respective poles of the battery." (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 221, 222; also *Gehlen's Journal*, Vol. I., 1803.)

A.D. 1803.—Mr. Carpue, in 1803, published some noteworthy experiments on the therapeutic action of common electricity. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electricity, pp. 105, 106.)

A.D. 1803.—M. Thillaye gave, in 1803, a great number of useful precepts on the medical application of ordinary electricity. He used electric brushes, held by an insulated handle and put into communication with the conductor of the machine. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 587, 588.)

A.D. 1803.—Aldini, in 1803, sent a galvanic current through the body of a criminal executed at Newgate. The most violent agitations and muscular contractions were produced. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 196, 197, and 221.)

A.D. 1803.—Mr. Dyekhoff, about 1803, made a dry electric column. (See Sturgeon's *Lectures on Galvanism*, p. 73.)

A.D. 1805.—Behrens, in 1805, constructed a dry pile of 80 pairs of zinc, copper, and gilded paper. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 852.)

A.D. 1805.—Romagnési, a physician of Trente, about the year 1805, observed that the magnetized needle "experiences a declination," when submitted to the action of the galvanic current. (See *Manuel du Galvanisme*, par Joseph Izarn, Paris, 1805, p. 120; also *Journal of the Society of Arts*, April 23, 1858, p. 356.)

A.D. 1805.—M. Mojon, a chemist of Gènes, about the year 1805, observed that unmagnetized needles, when submitted to the action of the galvanic current, "acquire, by this means, a kind of magnetic polarity." (See *Manuel du Galvanisme*, par Joseph Izarn, Paris, 1805, p. 120; also *Journal of the Society of Arts*, April 23, 1858, p. 356.)

A.D. 1805.—Brugnatelli, in 1805, "gilt in a complete manner two large silver medals, by bringing them into communication by means of a steel wire, with the negative pole of a voltaic pile, and keeping them one after the other immersed in ammoniuret of gold, newly made and well saturated." (See Smee's *Electro-metallurgy*, History, pp. 25, 26; also a letter from Brugnatelli to Van Mons in the *Philosophical Magazine*, 1805.)

A.D. 1807.—Sir Humphrey Davy, on October 6th, 1807, made his celebrated discovery of the compound nature of the alkalies. By means of a battery power of 274 pairs of plates, he decomposed potash, and found that potassium was formed on the application of galvanic power to a piece of moistened potash. Sir Humphrey's delight on this memorable occasion was excessive; on seeing the globules of potassium burst through the crust of the potash, and take fire as they entered the atmosphere, he could not contain his joy, and some time was required for him to compose himself sufficiently to continue the experiment. (See Noad's *Lectures on Chemistry*, pp. 32, 33; also Bakewell's *Electric Science*, pp. 33-35.)

A.D. 1808.—Napoleon, in 1808, presented a trough galvanic battery of 600 pairs of plates to the Polytechnic School at Paris. (See Lardner's *Handbook of Natural Philosophy*, Voltaic Electricity, p. 116.)

A.D. 1809.—Soemmering's telegraph was invented in 1809. In "this telegraph galvanic electricity was used, and as many wires were employed as there were letters or signals to be denoted. The letters were designated by the decomposition of water; an alarm was also added." (See Highton's *Electric Telegraph*, p. 39; also *Journal of the Society of Arts*, May 13, 1859, p. 453.)

A.D. 1809.—Mr. Childern, in 1809, formed a very large and powerful galvanic battery, upon the principle of Volta's *Couronne de Tasses*. The most refractory substances were fused by it, such as platinum (a bar one-sixth of an inch square), the oxides of molybdenum, tungsten, uranium, titanium, cerium, and tantalium, the compound ore of iridium and osmium, also diamond, blue spinell, gadolinite, and zircon; ruby, sapphire, quartz, and silex, were not affected. (See *Philosophical Transactions*, 1815, pp. 368-370; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 179, 222.)

A.D. 1810.—Coxe's telegraph was invented in 1810; he "proposed the use both of the decomposition of water and also of metallic salts." (See Highton's *Electric Telegraph*, p. 39.)

A.D. 1810.—De Luc, in 1810, made a "dry" pile of tinned iron and gilded paper. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 852.)

A.D. 1812.—Schilling, in 1812, proposed to blow up mines by galvanism. He ignited the powder by means of pieces of charcoal, and invented an "electro-conducting cord" to convey the electric fluid to the desired locality. (See *Journal of the Society of Arts*, July 22, 1859, p. 598.)

A.D. 1812.—Samboni, in 1812, constructed a dry pile of paper discs, covered on one side with tin and on the other with peroxide of manganese. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 852.)

A.D. 1812.—Ritter, about the year 1812, constructed his "secondary pile." This instrument consists of alternate discs of copper and moistened card, and is capable of receiving a charge from a voltaic pile, and of thence producing the physical, chemical, physiological effects obtained from the ordinary pile. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 206.)

A.D. 1813.—Sir Humphrey Davy, about the year 1813, discovered the convective discharge between charcoal or carbon electrodes, called "the voltaic arc." The galvanic battery of the Royal Institution, consisting of 2,000 pairs of zinc and copper, each having a surface of 32 square inches, and charged with acidulated water, was used to produce this phenomenon. The discharge took place through more than 4 inches of air, and 6 or 7 inches of vacuous space. "When any substance was introduced into this arc, it became incandescent; platinum melted in it like wax in the flame of a candle; sapphire, magnesia, lime—all the most refractory substances—entered into fusion. Fragments of diamond, points of carbon and of plumbago, disappeared rapidly, and seemed to evaporate in this focus, without appearing to undergo previous fusion." (See Davy's *Elements of Chemical Philosophy*, pp. 152-

154; also De la Rive's *Treatise on Electricity*, Vol. II., pp. 282, 283; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 176, 178, and 222.)

A.D. 1813.—Mr. J. R. Sharpe, of Doe Hill, near Alfretton, early in February, 1813, "devised a *voltaic* electric telegraph, which he exhibited to the Lords of the Admiralty, who spoke approvingly of it, but added, that as the war was over, and money scarce, they could not carry it into effect." (See *Repertory of Arts*, 2nd series, Vol. XXIX., p. 23; also *Saturday Review*, August 21, 1858, p. 190.)

A.D. 1815.—Dr. Wollaston, in 1815, invented his galvanic battery. Dilute sulphuric acid was the exciting solution; a plate of copper was placed on each side of the zinc, and the whole was arranged in a trough composed of a number of cells. By attaching the plates to a rod, the whole of them might be lifted out of the liquid at once. (See Highton's *Electric Telegraph*, p. 14.)

A.D. 1815.—Wollaston's celebrated thimble battery apparatus was constructed in 1815. It consisted of a flattened silver thimble, in which a zinc plate was fixed by sealing wax. This galvanic battery ignited a fine platinum wire by immersion in an aqueous solution of only one-fiftieth part of sulphuric acid. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 180, 181, and 222.)

THE PROPOSED DICTIONARY OF MECHANICAL FALLACIES.

As this has been thought rather anomalous and outré, a few thoughts on it may not be deemed out of place. The proposition is not so preposterous as it may seem, nor is it so at all. The principle is universally recognised. In all things we need to be shown the evil and the good. To appreciate the one we *must* know something of the other. While ignorant of follies, how can we become wise? Intelligence is a ceaseless struggle with error in social, civil, political, philosophical, mechanical, and every other department of life. In none is truth obvious at first; so far from lying on the surface to be stumbled on, it has to be sought for, dug for, and that earnestly and perseveringly. There are what may be called ordinary deductions, extrinsic rather than intrinsic, but truth is the inbeing, the essence of excellence in every thing. In the arts it is the shortest way to an object or end; it goes to it in straight lines, while error stumbles zigzag around it. It is swiftness, strength, elegance, or whatever the attribute may be. In forms and proportions it is beauty; in the absence of meretricious accessories and ornaments, it is taste. The simpler a machine is, the truer it is, for the expression of truth is simplicity. Then mechanical like moral verities only are enduring.

Another point about truth is, that people never speak of it as something to be estimated, as are lands, money, and goods, *by the quantity*. The idea seems to prevail that where it is, error cannot be, that the two can no more mingle than fire and water; whereas, truth is in reality alloyed in every conceivable proportion. Here it is largely manifest; there, like a grain of silver in a pig of lead, its presence is not suspected. It is therefore something of which a little will not suffice in physics any more than in morals. It may exist in a mechanical process or device, and be neutralized by association with fallacies; of which every poor machine is a proof. Results can only improve as it predominates; and herein lies the difference between the works of nature and those of man. In the former all is truth and consequently harmony and beauty, while discords and deformities characterize the latter. The best of these are to be improved by adding to the amount of truth in them.

As a class, to none is the caution, "Beware of Fallacies," more necessary than to inventors. Of all men they ought to know that truth is only to be reached through conflicts with error—through that which steals on them in flattering guise and captivates them with plausible counterfeits. It may seem strange that so many keen and shrewd inquirers fall into mechanical sophistries, and what is worse, fall in love with them, but the illusions are too seductive to be resisted. The fact is as true in physics as in morals,

> "When fiction rises pleasing to the eye,
> Men will believe because they love the lie."

Witness those who yet befool themselves with Perpetual-Motions, the grossest of mechanical falsehoods.

In ordinary as in the highest affairs, directions abound to prevent people from going astray. We have guide-posts for travellers on common roads, and Government spends millions to make seamen acquainted with shoals and other dangers of navigation by day, and on beacons and lighthouses, to direct them into safe harbours at night. For the benefit of merchants there are in most cities, "Commercial Agencies," institutions whose only capital consists of dictionaries of solvent and insolvent traders. And have we not lists revised weekly of counterfeit bank bills, and spurious coin? Naturalists are as earnest in discovering and making known noxious, as innocuous animals and plants, while chemists keep adding to the list of vegetable and mineral poisons. Such are examples of measures adopted to make evils known, that they may be avoided, and which are increased and extended as occasions call for them.

Why then, it may be asked, has nothing been done for those who are devoted to the progress of the arts to warn them of paths that lead them astray? Why should they be left without compass or chart to find their way over the ocean of speculation? Simply because the necessity for such help was not perceived or not sufficiently felt. If not yet palpable, it cannot, we should suppose, be much longer ignored. There is no valid objection to its removal, for whatever may be thought of the exposure of moral offences, the making public transgressions of mechanical laws can do no harm, but much good. A hand-book of errors is a guide book to truths. It would open the eyes and diminish the number of offenders.

As progress depends upon original thinkers, and especially those whose labours comprise the magnificent and minutest exemplifications of applied science, a work calculated to save them from loss of time, and much useless expenditure of thought and labour, must be of permanent and universal interest. But its value would not be confined to them. The reform it would work out in the Patent Office should not be overlooked, in abridging its labours, putting an end in a great measure to inadmissible claims, to disappointments and angry feelings attending rejected applications, to appeals of members of Congress in behalf of their constituents, to contingent fees of agents, and to other improper influences and interferences. Added to which it would raise the value of every legitimate claim, diminish the number of lawsuits, and give to the office an honourable reputation as an Institution of Science. Its reports would cease to record monopolies for ancient contrivances and modern abortions.

The running of anything like a parallel between the laws or principles of ethics and physics may be unusual, but is not improper, since they are intimately and inseparably allied. Emanations of the divine mind, they are equally divine. The same in their origin, essence, and purpose, it is they that impress the Deity on the material and the immaterial; hence the visible creation is an exhaustless exposition of the principles on which the arts must for ever rest; and nothing is more certain, whatever may be the case with transmundane intelligence, than that our species can only advance in civilization and happiness, as it advances in the knowledge and application of them. With us, moral truths begin with, and keep pace with, the physical. As a savage, man has no morals: they are incomprehensible to him. "Even the Arab robs the traveller with as little compunction as a bald eagle wrongs a fish-hawk, while the Feejian eats a missionary as unconscious of guilt as a tiger feasting on an antelope, or a lion making a meal of a Bosjesman." Material are moral forces. The hut and the hearth, the spindle and loom; the plough, forge and lathe; steamships, railroads, telegraphs, and printing presses, are products of mental and contributions to moral power. I mention these things because, to my mind, they are prophetic of the exaltation and influence of mechanical science to a degree that has probably not yet been suspected; and that the higher it rises the closer will be found its affinity with moral science. This *must* be so, since Truth in its infinitely varied forms and relations, like its Author, is ONE.

There are, and perhaps always will be, those who suppose the climax of mundane felicity was reached long ago. Panegyrists of former times, they think the world grows worse as it grows older. Looking back to a legendary age of gold, one of imaginary innocence and happiness, they mourn that it has passed away. An opposite and healthier sentiment now prevails, viz.; that the elements of civilization were never so numerous and so efficiently active; that great as has been the modern increase and diffusion of knowledge, and wonderful the achievements in science and the arts, all are but preliminary to others still greater. This is a corollary of the prime doctrine of progress; that nothing in creation remains stationary or is designed to retrograde. While we realize all that we are prepared for, we transmit it with an increased volume and impetus to our successors, whose mission it will be to forward it, in like manner, to theirs; every age being a debtor to the preceding one, and a creditor to that which follows it. Is it asked, how long can this continue—Can additions to human knowledge be perpetual? Yes: at all events, as long as the forms, motions, and properties of

matter here are not worn out. But may not the intellect become unequal to the successive development of new principles and management of new forces? No: It is indisputable that the more it is expanded, the more readily it apprehends and lays hold of new truths; and it is in a high degree probable that these become more lucid and simple as they become more comprehensive and sublime. —*Journal of the Franklin Institute.*

CORRESPONDENCE.

A HARD CASE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The case of Mr. Fourdrinier having caused so much discussion at the last meeting of the Electric and International Telegraph Company, respecting the £1,000 being voted on his behalf, I trust you will allow me to bring before you a few remarks upon the partiality thus shown in the distribution of the Company's bounty. I have not the presumption to allude to a case regarding the "first-class" officers, and am aware of the privileges gentlemen holding high positions in a company are entitled to, but the case to which I refer is that of the late Thomas Partridge, of Stoke-upon-Trent, who entered the Electric Telegraph Company at its first organization, eighteen years ago, and remained with it till the day of his illness, without ever having a blemish on his character. He was in the discharge of his duties in Harecastle Tunnel, testing the telegraph company's wires, when he was afflicted with a paralytic stroke. This occurred about 2.30 p.m. He was taken home by the train, and lay insensible for two months. When the poor man's money was paid, it was found (to the surprise of his wife) that the fourth part of a day's pay was stopped, which was the large sum of 11*d*. He lay for upwards of two years in a state of imperious want. On the suggestion of one of his fellow-workmen, application was made to the superintendent at Manchester, to allow a subscription to be opened on the line for his behalf. This was refused. After continued intercessions by the inspector at Stoke, he obtained the small grant of *£5*; after the man had spent the best of his days in the service of the Company, attending scrupulously to his duties. It certainly establishes a striking contrast between the head officers and the working man; as the one receiving a handsome stipend, and sheltered in a comfortable office from any bodily danger, has, apparently, a claim to entire sympathy, whilst the other, working hard for years in conditions often prejudicial to his health, or dangerous to his life, is scantily recompensed with the four hundredth part of what is now allotted to the ex-secretary. Of course the old adage will always be good :—" L'eau va toujours à la riviere."

Yours truly, OBSERVER.

RAILWAY TELEGRAPHS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I read with much interest the leading article in your last number entitled the "Egham Accident," in which you notice my train signalling telegraphs, pointing out some of their defects as well as some of their good points, and, as the question of signalling trains by telegraph is at present engaging the attention of railway managers, I shall feel obliged if you will permit me to offer a few remarks with a view to correct two or three errors that have been made in describing my instruments, feeling assured that your only object in permitting the article to appear in your useful journal was with the view of bringing the important subject of train signalling fairly under the more immediate notice of the railway world.

It is stated as a "defect" that my instrument "is worked by *one* line, and is actuated by *momentary* currents." Now this is not necessarily the case, for they can be readily adjusted and connected, so as to work with one, two, or more wires, and also with permanent currents should it be so desired; but as after several years' practical experience I find that one wire is the most efficient, and further, as in my opinion the employment of two or more wires with permanent currents constitutes an element of danger, I do not recommend their employment, except in certain very special cases where the peculiar nature of the traffic requires some special adaptation. In connecting up my instruments the battery circuit is not persistent, and does not, therefore, continually get weaker and weaker until failure of signals takes place, but is only called into action at the moment of transmitting a signal, and in the event of the line-wire being fractured, there is no possibility of the broken wire fouling either of the others (as is the case when two or three wires are employed), or of its permanent current dividing and entering one of them, thus recording a false signal at the distant station.

The indicators are not magnets, and therefore cannot be demagnetized, or their polarity reversed by lightning—a frequent cause of trouble and annoyance in needle instruments, and in some cases a frightful source of danger, by making one needle at a station show "line clear," whilst at the next station it shows "line blocked."

Again, "two opposite trains cannot be signalled at the same time." This is an error; two opposite trains can be signalled at the same time; but I would observe that such an act being contrary to instructions would subject the signalman to immediate suspension; the rule being that no one signal is to be considered complete until the reply has been received and acknowledged.

Again, "the wrong button may be pressed where the same signal has to be given at one time on one button, and at another time on a different button." I cannot understand how there is any "defect," the signalman in charge having constantly before his eyes a permanent indicator, showing *which* button is to be pressed, and has not to trust to memory. In some cases I employ a separate ringing key with *one* button, and as all call signals are made with this no mistake can occur.

In the construction of my instruments I have endeavoured to meet the requirements of every description of traffic, and, in order to suit the wishes of general managers and superintendents, have arranged the mechanical details in such manner that, in lieu of employing indicators, the dials can be fitted with miniature signals in exact accordance with the out-door signals employed on any particular railway—viz., semaphores, revolving discs, cross-arms, &c.

In conclusion, permit me to thank you for the flattering remark that "my instrument possesses many admirable points, and is extensively employed." I naturally infer that the latter result has been obtained in consideration of their "many admirable points," for although during the past twelve years I have had to contend against considerable opposition from several rivals, yet I am glad to say my instruments continue to make their way, and to give general satisfaction wherever they have been adopted.—Your obedient servant, EDWARD TYER.

15, Old Jewry Chambers, E.C., Sept. 7, 1864.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your article upon the "Egham Accident" I read a passage which—unless I misunderstand it—does not accord with my experience of the needle block system. In the passage to which I refer you say "They are the needle (Clark's, Spagnoletti's, &c.) and Preece's system as employed on the South-Western Railway; but the latter is immeasurably superior to the former, inasmuch as the man at one station has no control over the signals at his own station, and is fully and firmly assured by repeating signals that every signal sent is not only properly received, but duly acted upon."

Upon the London, Chatham, and Dover line of railway the telegraph block system is carried out to its fullest extent, and on the company's Metropolitan Extension the single needle block instrument, as modified by Mr. Rudall, has been used for the last two years with entire success. The dial of the instrument has on one side the words "line blocked" painted in bold capitals; on the other side are the words "line clear." A hole passing through the visible part of the axle of the reverser is fitted by a moveable pin, which, when in use, pegs the needle over to "line blocked." When it is necessary to send a train, say, from Herne-hill to Dulwich, the signalman at Herne-hill calls Dulwich by repeating three strokes of the needle to "line blocked." The man at Dulwich acknowledges this signal by repeating back three strokes of the needle, and then pegs his needle over to "line blocked," as permission for the train to come on. As soon as the train has cleared his station the man at Dulwich gives Herne-hill three strokes to "line clear." This signal is acknowledged, and the needles are left perpendicular until it is necessary to send on another train.

Now, Sir, the needle being pegged over by the man at Dulwich, Herne-hill has no control over it, and cannot use his instrument until Dulwich has unpegged and given "line clear." Is not that what is meant by "the man at one station has no control over the signals at his own station?" Again, every signal is acknowledged by repeating back the same number of strokes as given, and in the case of a "train out" signal, the needle is at once pegged over by the man who receives the signal. Is not the man who receives the acknowledgment "firmly and fully assured that every signal is not only properly received, but duly acted upon?" In addition to this, no train is allowed to leave one station until the signalman in advance has acknowledged the "train out" signal, and pegged his needle over; and in the event of the telegraph being broken down, or unintelligible signals being received on the instruments, every train is stopped, and the engine-driver and guards verbally cautioned to proceed slowly to the next station.

From the above I think it will be acknowledged that for every practical purpose the needle block, as used on this line, is a thoroughly efficient system. The only fault that can be alleged against it is the liability of the instruments to demagnetization and reversal. Should the first occur the telegraph would appear broken down, and should the needles become reversed unintelligible signals would be received. In either case the signalman would bring approaching trains to a standstill, and verbally caution the engine-drivers and guards.

I must apologise, Sir, for troubling you with this letter, but I am aware that your only object is to ascertain and make known the exact truth respecting all telegraphic matters, and therefore I am sure you will be glad to do justice to all parties by allowing each system its fair share of credit. I do not wish to question the advantages of Mr. Preece's instrument, but as it appeared to me that it was being specially praised for doing the same thing as our needle block, and I knew you had not personally examined our system, I thought you would pardon me for pointing out what appeared to be a discrepancy between your article and my experience.—I am, Sir, your obedient servant, W. H. FLOYD,

Assistant Telegraph Superintendent.

Telegraph Depôt, London, Chatham, and Dover Railway, Sept. 7.

AGGRAVATING FINES IN TELEGRAPH OFFICES.

To the Editor of the Telegraphic Journal.

Sir,—If through the medium of your paper you will allow me to call the attention of the executive committees of the several telegraph companies to the injustice consequent upon the irregularities in the existing system of "fining" for mistakes which may occur in the transmission of messages, you will confer a boon on telegraphists in general. What with contacts, failure of signals, disconnections, &c., it seems a great hardship to be fined at all, except in such cases where the error arises from sheer carelessness; but if the directory consider that this mode of punishment is indispensable, then, at least, let them see that it is administered as fairly as possible. It would appear that at present fines are inflicted according to the apparent magnitude of the error "upon paper," whereas they should be adjusted according to their actual magnitude when "practically analysed."

Again, the sender, receiver, and writer of a message is subjected to pay for an error which, by an experienced hand, can be easily traced to the sender, receiver, or writer individually, as the case may be. There is a kind of an appeal against these fines acknowledged, but as they (the fines) are always "paid under protest," and nothing is ever heard of the appeals, I presume that, protest or no protest, the result is equally lamentable. These irregularities could be remedied by the appointment of supervisors practically acquainted with the working of the different codes, who would be able to judge of the magnitude of the mistakes, and by whom committed. I believe that in the Electric Company the money produced by fines is contributed to the maintenance of a "clerks' library," and need scarcely add that the Magnetic Telegraph employés would be very thankful if such a privilege be extended to them. Trusting that I shall not intrude too much upon your space,—I am, Sir, your obedient servant, A Victim.

COVERING COPPER WIRE, &c.

To the Editor of the Telegraphic Journal.

Sir,—Would you or any of your readers kindly give me a description of a simple machine for covering copper wire with silk or cotton, for making induction coils, or, if that would take too much space in your valuable journal, would you kindly refer me to any book, or paper, that contains a description or drawings of the same? Would you also kindly state what is meant by *resistance coils*, and how made, and what they are used for? An early reply to the above will greatly oblige, Volta.

[Our correspondent will find the information as to the resistance coils, and their application, in the appended extract from a valuable paper by Mr. W. H. Preece, on the testing of submarine cables:—"The basis of all resistance tests is the fundamental law of Ohm, which is expressed by the formula:—

$$R=\frac{L\,C}{S},$$

where R=the resistance;
L=the length of the wire;
C=the specific resistance of the material employed;
S=its sectional area.

The specific resistance of different metallic bodies (C), varies considerably, as will be seen from the following relative conducting powers of different metals, according to Becquerel:—

Copper	100	Platinum	16·4
Gold	93·6	Iron	15·5
Silver	73·6	Mercury	3·45
Zinc	28·5		

The relative conducting powers of iron and copper, which are the materials usually employed for telegraphic purposes, are, consequently, as 15·5 to 100, or as 1 to 6·45 nearly. The resistance of a wire is directly as its length (L), and inversely as its sectional area (S.) If A B represents a copper wire 1 mile in length, and C D one 10 miles in length, both being of the same dimensions and material, the resistance of C D will be exactly ten times that of A B; but if the sectional area of A B is reduced to one-tenth, then the resistance of A B will be exactly equal that of C D. Again, if the wire A B is made of iron instead of copper, the same dimensions being retained, the resistance of A B will be six and a-half times greater than that of C D. If now, A B is reduced to six and a-half times its length, its resistance will again equal that of C D. Thus a short length of fine iron wire, will offer the same resistance to the passage of an electric current as a long length of ordinary-sized copper wire, and will produce the same phenomenon. One mile of No. 40 iron wire offers the same resistance as about 500 miles of No. 16 copper wire. Short lengths of this iron wire are cut to represent any separate lengths of copper wire of the usual dimensions, and are wound round bobbins, forming a series of what are called "resistance coils." They can be made to represent any length of cable, but the series usually constructed consist of 221 miles of No. 16 copper wire. By these means, the resistance of any cable can be ascertained, it being only necessary to compare the resistance of the material of which it is made with that of No. 16 copper wire. Thus the resistance of the Channel Islands cable is to that of No. 16 copper wire as 36 to 17; consequently, 17 miles on the author's resistance coils are equal to 36 miles of the Channel Islands cable. In the case of the Gibraltar cable 1 mile on these coils would represent 8 miles of that cable."—Ed. T. J.]

TELEGRAPHIC NEWS.

The Telegraph in Russia.—*Le Moniteur*, in a despatch, dated Trebizonde, 19th May, announces that telegraphic communication has been established between Constantinople and Trebizonde.

The Telegraph at Buenos Ayres.—By the last mail we have the following information to the 27th July:—"Congress is still sitting. A bill granting a concession for the construction of a telegraph line between the city of Buenos Ayres and Monte Video has been passed."

The Persian Gulf Telegraph Cable.—Owing to a break in the submarine telegraph cable of the Persian Gulf line, it has been announced that no more messages will be sent by that line beyond Gwadur, until further notice. The Amberwitch has been dispatched from Bombay, to pick up the cable and repair it.—*Times of India.*

Colonial Telegraphy.—The telegraphic extension from Deniliquin to Hay (New South Wales), a length of eighty miles, was opened for messages on the 9th of June, having previously been inspected by the superintendent of telegraphs. Progress is being made with the extension from Wellington to Dubbo, and also with that from Braidwood to Queenbeyan; the latter line will soon be finished. The tender of Mr. D. Macquarie had been accepted for the extensions from Mudgee to Murrurundi, at a cost of £37 per mile.

Telegraphing without Wires.—Experiments are now in progress, both at Mount Valerien and Vincennes, for the purpose of testing a new system of electric telegraphy invented by M. Armand Douat, who, it is said, has found means to do away, as Mr. Haworth has already done in England, as stated in his specification, with conducting wires altogether, and transmit despatches by the sole action of the earth. A zinc and a copper-plate, bent in spindle-like shape, are buried in the ground, with their convexity turned in the direction in which the despatch is to be sent.

The late "Eisteddfod" at Llandudno.—We quote the following from the *Carnarvon and Denbigh Herald*, of the 3rd inst.:—"The want of a telegraph station, much as its absence has been complained of, was never so much felt as during last week, when, to ensure the transmission of a message, it was absolutely necessary for the sender to go down to the junction with it, and see it safely on the wires. Will it be credited that, in these days of modern improvements, a town with a resident population of more than 3,000, and a summer population of more than treble that number, having a railway station itself, and being within four miles of another on the principal line in the kingdom, can still be without a telegraph station. Yet that such is the case we ourselves had only too certain a proof on Friday last, when a message, sent by us from Carnarvon, to our reporter at Llandudno, was *only* four hours, from the time it reached the junction, until it was delivered to the "chiel," who was then sleeping the sleep of the just. This is not a singular instance by any means; a gentlemen complained, but a few days previously that a message sent to him was delayed over three hours at the Llandudno station."

Telegraphic Aid to Commerce in Jerusalem.—"Jerusalem," says the British consul in his year's report to the Foreign Office, "is the least commercial or industrial city I know." British trade is represented by one English tradesman, who keeps a store for English upholstery, drapery, and fancy goods. The population of the city is computed at 15,000, rather more than half of them Jews, the rest Moslems and Christians. The chief native industry is the manufacture of soap and "Jerusalem ware," this latter consisting of chaplets, crucifixes, beads, crosses, and the like, made for the most part at Bethlehem, and sold to the pilgrims, who annually flock to the holy city to the number of about 6,000. The population of the entire Sandjak, or province, is estimated at 200,000, of whom 160,000 are Mahometans. Owing to the absence of good roads and the insecurity arising from the predatory tribes of Bedouins inhabiting the outskirts of the district, but who could easily be kept in check, vast and fertile plains lie waste or are but partially and poorly cultivated; factories are not to be met with, and no mines are worked, though it is believed that sulphur, bitumen, and rock salt abound on the shores of the Dead Sea. The principal, if not the only imports from England are cotton goods, and some colonials, but the former have much diminished since the cotton crisis; it is calculated that 300 bales of these goods, of the value of £16,000, annually find their way here. The exports are olive oil and grain. Very little is done in cotton culture, what is raised being of inferior quality and consumed on the spot; but it is believed that in many parts of the country cotton to a large extent might be successfully cultivated, with good seed and proper instruction and implements given to the peasantry. The vegetable produce is barely sufficient for local requirements. Jaffa is the port through which Jerusalem deals with foreign countries. The trade of Jaffa experienced a considerable increase in 1863; the quantity of cotton exported rose from 55,000 lbs., in 1862, to nearly ten times the amount in 1863, with a prospect of this being again trebled or quadrupled in 1864. This was owing to the interest exercised. The merchants who operated in cotton made a profit of 25 per cent. There are regular lines of French, Austrian, and Russian steamers, all doing well, and very often large quantities of goods have to be left behind for want of room; but only one English steamer visited Jaffa in 1863. The exports exceeded £200,000; of the imports no statistics are kept. The consul reports a telegraphic line in course of formation by the Government between Beyrout and Jaffa, thence to be carried on to Alexandria.

TELEGRAPHIC BRIBERY.—Two wealthy merchants of Ahmedabad have been sentenced to three months' imprisonment for bribing an electric telegraph signaller.

TELEGRAPHIC COMMUNICATION BETWEEN CAIRO AND CONSTANTINOPLE.—In the course of a few days (says the *Levant Herald*) Constantinople and Cairo will be in telegraphic communication. The electric current, flashing over a distance of 1,800 miles, will connect the capital of Turkey with the chief city of its great Egyptian dependency. The Turkish authorities have already finished their part of the undertaking. On the 12th ult. the telegraphic line was completed as far as El Arish, on the Turco-Egyptian frontier, and it is understood that, in two or three days, the Egyptian engineers will link their portion of the line to that of their Ottoman *confrères*, and so complete the whole. There will be a double line of wires throughout the distance, one for messages in Turkish and Arabic, and the other for messages in French and other European languages. A convention is on the point of being concluded between the Turkish and Egyptian telegraphic administrations, by which the tariff of rates for the dispatch of messages will be fixed, and thus, within a week hence, the public in Constantinople will be in a position to communicate by telegraph direct with Cairo, or with any of the intermediate stations on the line. The commercial and general advantages which the completion of this line offers are too manifest to need comment.

EUROPEAN TELEGRAPHS.—The telegraphic lines in France, exclusive of those used by railways, comprise 96,446 kilometres (each three-quarters of a mile) of wire, and 1,301 offices, which yearly transmit about a million and a-half of private despatches, and nearly as many official ones. Russia has 48,840 kilometres of wire; Austria, 29,640; Italy, 25,561; Prussia, 32,223; Spain, 23,665; Belgium, 6,236; Switzerland, 4,960. In none of these countries is the telegraphic administration connected with the post-office. In Spain, as in France, the telegraphs are under the control of the Minister of the Interior. In Russia, Prussia, and in Italy, they belong to the Ministry of Public Works. In Belgium, the telegraph, railways, and the post-office, form a general direction under the Minister of Public Works, but are kept distinct. In Austria, the administrations of the telegraphs and the post-office were at one time united, but it was found expedient to separate them. In Switzerland the telegraphic organisation is nearly the same as Prussia; the post-office, customs, and private establishments supply the elements of an auxiliary staff, but all the persons employed depend on the Administration of Telegraphs, and are paid, after the budget, for whatever concerns the service. There is, therefore, no foundation whatever for the assertion made by the committee on the budget, to the effect that the practice of several neighbouring countries demonstrated that the union of the post-office and the telegraph service presented an impossibility. Such practice exists elsewhere.

MISCELLANEA.

A "JAW-BREAKER."—As an instance of the abominable system of terminology at present adopted by chemists, it may be mentioned that Mr. M. H. Schiff, in a monograph on some derivatives of ethylidine, states that he has succeeded in obtaining a chloride of *dimercurodiethylidinediphen-ammonium*. If any one out of the laboratory can pronounce this awful term, we shall be very much surprised.

MAKE HASTE SLOWLY.—There is an old Latin proverb (*Festina lente*) which says, "hasten slowly." It is rarely that we find two words which express so much or contain more food for thought. As a nation we make haste too fast, and should do better to go much slower and more surely to our goal. Some individuals manifest this disposition to hurry over important things differently from others, but the application of the fault alluded to may be understood by the following illustration:—Suppose a person to require information upon some subject he is comparatively ignorant of—the steam engine indicator, for instance; having procured a book upon it, he runs his eye over page after page, touching first upon this example, now upon that, until he arrives at the end, when he knows nothing whatever of the subject. The first time he undertakes to converse upon the instrument or to apply its principles practically, he discovers his ignorance, and is put to shame or inconvenience. All this is wholly the fault of making haste to reach the end, without grasping the fundamental principle and mastering it, and each detail also, before going further. It is absurd to suppose that any matter worthy of study can be mastered in a cursory examination, yet very many persons relinquish the pursuit of knowledge in despair from this very cause. Finding it impossible to comprehend in fifteen minutes some point it has taken an author as many days, and weeks, probably, to settle, they deem the matter beyond their comprehension, and throw up the study never to return to it. There may be some gifted spirits to whom the knotty points of a new theory, or the intricacies of an unfamiliar science are clear and plain at first sight, but the mass acquire knowledge only by patient study, not by a hand-gallop through the fields of learning. When sensible men go abroad to acquire information in foreign countries they do not take express trains and steamboats, and whirl onward to the end; but, staff in hand, they penetrate into village and hamlet, and learn from the peasant and the prince. So it is with those who study to learn, and retain what they read. Patient plodding by the wayside is better than running from pillar to post, and the truth of this assertion is manifest to all who have ever given the subject attention.

INTELLIGENCE AND WEALTH.—Now, it is obvious that there is nothing in the profession of abstract science, let it be ever so successfully practised, which will certainly lead to the acquisition of wealth; and by wealth I mean what a successful London banker, merchant, or lawyer would term wealth. It is the practical men who generally contrive to run off with the sugar plums of science; and there is no reason why they should not. What these men do is palpable and manifest to the public, but not so the work of the philosopher, to which they are most deeply indebted. Every one wonders at and admires the electric telegraph, but how few think of the philosopher who discovered the law upon which the whole system depends? Just so is it with the art of electro-plating. The names of electro-platers may be known to the world, but how little those of the men who laid the foundation of the science of that valuable art! The magneto-electric machine, now so usefully applied, was the result of a discovery by Mr. Faraday, which, although it did not confer wealth on its author, yet has made others rich. I might go on multiplying examples until I should fill all the columns of the *Telegraphic Journal*, but those above-mentioned shall suffice. The conclusion which I would draw is, that, there may be intelligence which is worth something, though it make not wealth for itself.

THE MYSTERIES OF IRON.—There is no miracle recorded in the annals of any religion more mysterious, more incomprehensible, more inconceivable, than some of the well-known properties of the simple metal, iron. Consider, for instance, its change from its ordinary to its passive state. If a piece of the metal in its ordinary condition is immersed in nitric acid, it is powerfully acted upon, entering into combination with the acid and losing its metallic form; but if a piece of platinum wire has one end inserted in the acid, and the iron is then immersed in contact with the wire, it is so changed that the acid has no power upon it, and this condition continues after the platinum wire is withdrawn. The contact of a single point with the platinum sends a transformation through all of its particles which renders them invulnerable to the attacks of the most powerful acid. Even more wonderful is its change under the influence of a current of electricity. When a bar of pure soft iron is wound with an insulated wire, and a current of electricity is sent through the wire, the bar is instantly converted into a magnet; it is endowed with an unseen force which stretches out from its ends, and seizing any other piece of iron within its reach, draws them to itself, and holds them in its invisible grasp. The object of insulating the wire is to prevent the electricity from leaving it, and yet through this insulating coat a power is exerted which changes so strangely the nature of the iron, enabling it to act on substances with which it is not in contact. As soon as the circling current ceases, the iron becomes like Sampson shorn of his locks, its miraculous power has departed. Not less mysterious than either of these is the more familiar phenomenon of the fall of a piece of iron to the ground, under the simple action of gravitation. What is that invisible force which reaches out in all directions from the earth, and clutches all matter in its grasp? The fibres of this power are imperceptible to any of our senses. If we pass our hands under a suspended rock we can feel nothing reaching from it to the earth; and yet there is something stretching up from the earth, taking hold of the rock, and drawing it down with the strength of a hundred cables! We walk enveloped in mysteries, and "our daily life is a miracle."—*Scientific American*.

INDIA-RUBBER MANUFACTURE.—India-rubber, under the hands of inventive men, has become one of the most widely and diversifiedly-applied substances in the modern arts. Not many years ago it was simply known as an elastic resin (misnamed "gum") termed caoutchouc, which was made into certain articles that were impervious to air and water; but it became sticky and soft at a low heat, and was therefore unfit for common purposes. In a pure state it is still incapable of being very usefully applied, but by combining it with other substances, especially sulphur in small proportions, and submitting it to heat—the process called "vulcanisation"—it is made to retain its elasticity, and at the same time resist the action of heat to soften it at temperatures below that of common steam-heat. Waterproof overcoats, blankets, shoes, toys, and numerous other articles are manufactured out of elastic vulcanised rubber, while pencil and pen-cases, combs, rollers, flutes, canes, &c., are made of hard vulcanised rubber. The manufacture of toys, belting, and water-hose is carried on upon a large scale by the New York Rubber Company, in their factory at Wiccapee, situated in a romantic dell on Fish Creek, near the Hudson river, in Dutchess county. We lately enjoyed the pleasure of visiting this factory, and witnessed the various operations of grinding, mixing, calendering, moulding, vulcanising, and finishing the various products. The rubber is first ground, or rather kneaded between large iron rollers, and during this operation it is mixed with other substances, such as white lead, &c. It is here reduced to sheets, resembling bakers' dough, which are afterwards submitted to a "calendering" action—that is, they are pressed between large, heavy, polished iron rollers. Several machines having three rollers, placed one above another, are used; and one has four rollers, between which the mixed rubber is passed three times, and reduced to beautiful, smooth, and thin sheets. From such sheets the several parts of hollow dolls, balls, globes, &c., are stamped in dies, then the parts are united with rubber cement, trimmed, and fitted into metallic flasks of different patterns, then placed in batches in a large horizontal iron oven, where they are submitted to the action of steam of about 240° Fah. for five and a-half hours. The articles are secured upon a carriage, and moved upon a railway into the oven, one end of which opens and closes, forming a large man-hole. After the goods are vulcanised they are finished and

painted. Hundreds of designs and moulds for different articles are used in this manufactory, and artists are constantly employed in getting up new designs and making new moulds. The high price of leather has caused much attention to be devoted to the manufacture of some suitable substitute for it in large beltings, and success has been attained with india-rubber combined with strong flax-duck, made for the purpose. The fabric is woven in looms, and several plies of it, stitched together by machines, are cemented with india-rubber, and then cured by solar action. We were told in the factory that india-rubber belting, cured by vulcanisation, is not so durable, owing to the strength of the flax-cloth body being impaired by the high steam-heat. We examined one belt, 3 feet in width and 252 feet in length, which weighed about 1,600 lbs., and cost from $1,800 to $1,900. It was made for the driving-belt of an elevator at St. Louis, and another of the same size, for a similar purpose, has been ordered for the Milwaukee and St. Paul Railway. This belting is composed of five plies of stout flax-duck, and it has twenty-seven rows of stitching in it. A very large business in manufacturing such belting is now carried on at this place. Orders for nine belts, each 22 inches wide and 269 feet in length, are now being fulfilled. India-rubber hose are made of strong flax-duck, which is woven here in tube form, in looms adapted for the purpose. After coming from the loom the flax-duck hose, of a certain length, is laid upon a long table, and wrapped around on the outside with a layer of india-rubber in a sheet. This is cemented to the duck, and is to form the inside of the hose. A long iron rod is now thrust through the inside of the hose, and hooked at the back end. The hose is now drawn over this rod by a reel, and turned inside out like a stocking, after which another layer of sheet rubber is laid and cemented upon the outside, thus forming a perfectly close hose, water-tight inside and out, without a rivet from end to end. Of course, such hose is far stronger than that made of leather. It must be gratifying to machinists, millwrights, and engineers to know that such heavy and strong belting is now manufactured, and that it is capable of withstanding the action of the weather in a very superior degree to leather. So far as we can recollect we have never seen leather belting of such dimensions made or used anywhere. —*American Artizan.*

Telegraphing without Wires.—In order to account for a class of spirit manifestations, writers assume that two human brains, placed at a great distance from each other, may become filmily meshed together by odylic threads, so as to form a double cerebral unit; the impressions of the stronger brain being communicated to and through the weaker. Thus, a brain situated in England can be placed *en rapport* with a brain in Australia, and can telegraph impressions across the globe, imparting information to and through the medium, which neither the medium nor any one in the circle could otherwise have any knowledge of. In this way events occurring in distant places may be accurately described, and sentences be spelled out, partly by the automatic action of the brain of the medium, and partly by the automatic agency of some co-efficient brain in a distant place. The hypothesis can be extended to past events by supposing them to have left a permanent impression on the all-pervading odylic medium. By this theory, all communications received through writing, tipping, rapping, and speaking mediums are accounted for.

The Chemistry of Earth and Air.—M. Bousingault, in writing upon the subject of the nitric formations of Tacunga, explains how easily nitrate of potash is developed in the atmosphere:—Nitre is almost universally distributed, and is very rapidly formed. It results from the oxidation of the nitrogen which is contained in the atmosphere, and its combination with the potass of the soil. Schœnbein has shown that even where no potass exists, there is ammonia formed by combination of the nitrogen and hydrogen of the atmosphere, and this then unites with the nitric acid, forming nitrate of ammonia. These combinations are not deemed worthy of consideration by British agriculturists, who apply ammonia to their soils artificially. In Saxony a very different state of things exists, for there Baron Liebig's views are carried out to the letter.

Why Bees Work in the Dark.—A lifetime might be spent in investigating the mysteries hidden in a bee-hive, and still half of the secrets would be undiscovered. The formation of the cell has long been a celebrated problem for the mathematician, whilst the changes which the honey undergoes offer at least an equal interest to the chemist. Every one knows what honey fresh from the comb is like. It is a clear yellow syrup, without a trace of solid sugar in it. Upon straining, however, it gradually assumes a crystalline appearance—it *candies*, as the saying is—and ultimately becomes a solid mass of sugar. It has not been suspected that this change was a photographic action. That the same agent which alters the molecular arrangement of the iodide of silver on the excited collodion plate, and determines the formations of camphor and iodine crystals in a bottle, causes the syrupy honey to assume a crystalline form. This, however, is the case. M. Scheibler has enclosed honey in stoppered flasks, some of which he has kept in perfect darkness, whilst others have been exposed to the light. The invariable result has been that the sunned portion rapidly crystallizes, while that kept in the dark has remained perfectly liquid. We now see why bees are so careful to work in perfect darkness, and why they are so careful to obscure the glass windows which are sometimes placed in their hives. The existence of their young depends on the liquidity of the saccharine food presented to them, and if light were allowed access to this the syrup would gradually acquire a more or less solid consistency; it would seal up the cells, and in all probability prove fatal to the inmates of the hives.—*Quarterly Journal of Science.*

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2123. R. A. Brooman, improvements in signalling apparatus, especially applicable to signalling on board ship.—A communication.

2134. G. Wilton, improved means of communicating between passengers, and between passengers and guards, on railways.

2141. Sir J. Mackneil, improvements in railway signals.

2147. J. H. Johnson, improvements in apparatus for sounding alarm or signal bells.—A communication.

2151. J. S. Guy, improvements in apparatus for enabling passengers travelling by railway trains to communicate with the guard and driver.

2158. A. M. J. Count de Molin, an improved electro-magnetic engine.

2165. J. Barber, improvements in communicating, watching, and signalling throughout railway trains.

GRANT OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1840. T. P. E. Le Boulenge, an electro-balistic chronographe.

PATENT SEALED.

562. C. Humfrey, improvements in vulcanizing india-rubber.

PATENT WHICH HAS BECOME VOID.

2249. J. Ronald, improvements in laying or depositing submarine telegraph cables.

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

2185.—W. Clark, improvements in signal apparatus applicable for the prevention of railway-train collisions.—A communication.—2nd September, 1861.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.

India Rubber.

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Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	102 to 106	—
100	Submarine Telegraph, registered	all	45 to 50 x. d.	—
all	Do. scrip	all	[illegible] to [illegible] x. d.	—
5	United Kingdom Telegraph .	8	1 to $\frac{1}{2}$ dis.	—
10	Mediterranean Extension Tel. .	all	8 to 8$\frac{1}{2}$	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{1}{2}$ dis. to par	3$\frac{7}{8}$-$\frac{1}{2}$

TO CORRESPONDENTS.

D. E. H.—Your observations with respect to the telegraph company in question are perfectly correct. We desire to act in a fair and impartial manner towards all the companies in recording their proceedings. We thank you for your promised assistance, and shall be very glad to avail ourselves of the same at all times.

A Nautical Man.—A system of electric ship-steering signals has been patented by Lieutenant A. Gilmore, R.N., and Mr. W. H. Preece, C.E., which has been approved and adopted by the Lords Commissioners of the Admiralty.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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THE TELEGRAPHIC JOURNAL.

Vol. II. No. 38.—September 17, 1864.

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THE SUCCESS OF TELEGRAPH COMPANIES.

The tendency of the present generation to speculate, and the passing of the Joint Stock Companies' and Limited Liability Acts, have given opportunity to adventurers to impose upon the public; but of the 2,000 projects recently introduced into the money market we have failed to recognise a telegraphic undertaking which has not a legitimate claim to support. We have of late years fallen into a grievous error in estimating the character of men and institutions by the amount of cash at their bankers. If we wish to ascertain the status of any useful Company we generally refer to the columns of the *Times* for information as to the price of its shares, and on the returns of the "leading journal" we base our conclusions. But in this we may err. Notwithstanding that telegraph shares are at a discount, and offer but little inducement to investors, the various undertakings pay exceedingly good dividends, as will be seen on reference to official documents. On a previous occasion we directed attention to the continued success of the Electric and International and the Magnetic Telegraph Companies. We now take the opportunity of noticing briefly the reports of the Submarine and the Universal Private Telegraph Companies.

The Danish war materially affected the operations of the Submarine Telegraph Company, as, owing to the difficulties in Schleswig and Holstein, their cables were not allowed to be used. It should be mentioned, however, that although telegraphic communication was suspended, the line was treated with the utmost respect by the belligerents, and remained intact to the conclusion of the war. Accordingly the revenue from this source was considerably reduced. The receipts of the Company for the past half-year were mainly earned on the French and Belgium lines. A very large increase in the number of messages transmitted by these lines is shown in the accounts, which are of a very gratifying character. A progressive business has been done (notwithstanding the drawback to which we have adverted), every provision has been made to meet the probable extension of traffic on the continental lines, and a dividend at the rate of 5 per cent. per annum has been declared on the capital—an issue to the half-year's proceedings which is as satisfactory to the chroniclers of telegraphic progress as to the holders of shares in the undertaking.

The Universal Private Telegraph Company is in a very promising condition. At the recent extraordinary general meeting a dividend of 6 per cent. per annum was resolved upon, and hopes were expressed that still larger returns upon capital would be realized. The Act of Parliament under which the above Company was established only requires that one meeting of the shareholders shall be held annually; but the Directors on reviewing their accounts for the half-year ending 30th June, were so satisfied of the eminently remunerative character of the business, that they determined to summon a special meeting whereat they could recommend an interim dividend. The important position which this Company has attained is to be attributed mainly to the indefatigable exertions of the officers. A question—and a very proper question, considering the recommendation of a dividend of 6 per cent.—arose as to the honorarium of the Directors, who had to the date of the last meeting served the Company without fee or reward. During the period of development of any enterprise it is necessary for the Directors to devote themselves assiduously to their duties, and to wait for an acknowledgment of their labour until such time as the project arrives at maturity. When a Company attains to the condition of paying a handsome dividend to the shareholders, the latter should be liberal in their award to their Directors. In the case under consideration it is evident that all the officers of the Company united to bring about so satisfactory a result as appeared in the statement presented at the last meeting. The shareholders would seem to be aware of the services rendered by the Board of Directors, and unanimously resolved to award them the sum of £600 per annum, and their travelling expenses.

From the foregoing it will be observed that telegraph property is increasing in value, and that it requires no prophetic faculty to enable any one to perceive that in the course of a few years the remunerative character of telegraphs will be established. In bringing these remarks to a conclusion, we must congratulate the officers of both the Submarine and Universal Private Telegraph Companies on the status which their several undertakings have attained, and express a hope that the future to them may be more prosperous than the past.

TELEGRAPHIC CORRESPONDENCE BETWEEN MALTA AND THE CONTINENT.

It is with regret that we have to announce the probability of suspension of a very important telegraph service. No greater calamity could befall a civilized nation than to be deprived of either its literature, its railways, or its telegraphs. Yet one of our most flourishing dependencies appears likely to be called upon to sacrifice its means of telegraphic communication. The spirited gentleman who undertook to do for Malta what Mr. Julius Reuter has done, and is doing, for England and other European nations, alleges that "it doesn't pay," and has intimated that, unless the enterprise receives increased support, either the number of telegrams must be reduced or the correspondence must be discontinued. The *Malta Observer* thus adverts to the inconvenience which would result from the cessation of operations on Stefani's line of telegraph:—

"Our readers will remember that in May, 1863, a proposal was started having for its object the establishment of telegraphic correspondence between Malta and Turin, in order that the public of Malta should be made aware of any political events of great importance passing abroad. This useful proposal received the support of about fifty subscribers during a year, enabling Stefani—the *Reuter* of Italy—to forward twenty-six telegraphic messages per quarter—that is, two telegrams a week—for the sum of £21 a quarter. The total annual subscriptions amounted to about £100, so that there remained £16 to pay for a year's printing and distribution of the telegraphic bulletin. Every honest and intelligent person will admit that the *service* cannot be executed better than through Stefani of Turin, as his agency is the only one at present existing in Italy, and his terms are very moderate. However, this year, instead of an increase in the number of subscribers, thirteen have dropped their subscriptions, and only four have come forward to support the proposal. Six subscribers have left the island, and have also discontinued their subscriptions. We will not stop to inquire into the *causes* that may have induced some of the subscribers to withdraw their support from a useful and harmless undertaking; but we publish a list of the present subscribers, and a list of those who have discontinued their subscriptions. It will be seen that, unless the enterprise receives support and encouragement from respectable English residents and Maltese merchants, either the number of telegrams must be reduced or the correspondence must be dropped entirely. We leave the matter in the hands of the public of Malta, hoping that some proof of public spirit will not be found wanting, and that it shall not be said abroad

that no commercial life nor public spirit exists in Malta. It is true that thousands of persons read the telegrams at the Exchange, in the clubs, libraries, and cafés, and that these public establishments ought to subscribe for several copies of the telegram, in order to encourage a *requirement*, particularly when neighbouring cities are in possession of daily telegrams, and Malta is as rich as any of them. For our parts we shall support the correspondence for a time even at a loss, trusting that on reflection, and in brighter moments, those subscribers who have withdrawn their *patronage* will feel pleasure and honour in supporting so good and useful an undertaking. If it fails, the public will know to whom the failure is to be attributed.

"The following is a list of the present subscribers to the telegraphic bulletin:—

"The Chief Secretary to Government; Major W. Brett; Casino Maltese; Hon. E. Scicluna; Messrs. Rose & Co.; Peninsular & Oriental Company; Mediterranean Extension Telegraph-office; Chevalier R. Slythe; Messrs. James Bell & Co.; Mr. W. Winthrop; La Borsa; Mr. John Rose; Marquis Drago; Mr. G. Grant; Sir A. Dingli, C.B.; Mr. George Muir; Hon. V. Bugeja; officers' mess, 2-22nd Regiment; Mr. W. A. Dewar; Admiral Superintendent; Messrs. P. Stuart & Co.; Messrs. Degiorgio & Muscat; Hon. Dr. Sciortino; Malta Union Club; Garrison Library; Messrs. Eynaud & Co.; Messrs. Petrocochino & Co.; Mr. C. A. Wright; Hon. Dr. Torreggiani; Messrs. Glass, Elliot, & Co.; officers' mess, 1-22nd Regiment; *Times of India*, Bombay; Mr. G. Ellul; officers' mess, 2-8th Regiment; Mr. A. Terreni; Sergeant Robertson, 2-4th Regiment; Mr. Ramiro Barbaro, and Colonel McIver.

"*Subscribers who have left the Island.*—Major Newdigate, R.B.; officers' mess, 2-15th Regiment; officers' mess, 1-25th Regiment; Dr. R. Turner; and Rev. Mr. Fox.

"*Subscribers who have discontinued.*—Messrs. Smith & Co.; Messrs. Ferro & Co.; Mr. S. Baldacchino; Mr. O. F. Gollcher; Mr. G. Montano; Mr. E. Zammit; Mr. A. Duncan; Hon. Dr. Mifsud; Messrs. Woodhouse & Co.; Mr. G. Bonavia; Mr. T. Sceberras; Messrs. R. Duckworth & Co.; and Messrs. B. Tagliaferro & Sons."

ON RADIATION THROUGH THE EARTH'S ATMOSPHERE.*

BY JOHN TYNDALL, ESQ., F.R.S.

NOBODY ever obtained the idea of a line from Euclid's definition that it is length without breadth. The idea is obtained from a real physical line drawn by a pen or pencil, and therefore possessing width; the idea being afterwards brought, by a process of abstraction, more nearly into accordance with the conditions of the definition. So also with regard to physical phenomena; we must help ourselves to a conception of the invisible by means of proper images derived from the visible, afterwards purifying our conceptions to the needful extent. Definiteness of conceptions, even though at some expense to delicacy, is of the greatest utility in dealing with physical phenomena. Indeed, it may be questioned whether a mind trained in physical research can at all enjoy peace without having made clear to itself some possible way of conceiving of those operations which lie beyond the boundaries of sense, and in which sensible phenomena originate.

When we speak of radiation through the atmosphere, we ought to be able to affix definite physical ideas both to the term atmosphere and the term radiation. It is well known that our atmosphere is mainly composed of the two elements, oxygen and nitrogen. These elementary atoms may be figured as small spheres scattered thickly in the space which immediately surrounds the earth. They constitute about 99½ per cent. of atmosphere. Mixed with these atoms we have others of a totally different character: we have the molecules, or atomic groups of carbonic acid, of ammonia, and of aqueous vapour. In these substances diverse atoms have coalesced to form little systems of atoms. The molecule of aqueous vapour, for example, consists of two atoms of hydrogen united to one of oxygen, and they mingle as little triads among the monads of oxygen and nitrogen, which constitute the great mass of the atmosphere.

These atoms and molecules are separate, but in what sense? They are separate from each other in the sense in which the individual fishes of a shoal are separate. The shoal of fish is embraced by a common medium, which connects the different members of the shoal, and renders intercommunication between them possible. A medium also embraces our atoms; within our atmosphere exists a second and a finer atmosphere, in which the atoms of oxygen and nitrogen hang like suspended grains. This finer atmosphere unites not only atom with atom, but star with star; and the light of all suns, and of all stars, is in reality a kind of music propagated through this interstellar air. This image must be clearly seized, and then we have to advance a step. We must not only figure our atoms suspended in this medium, but we must figure them vibrating in it. In this motion of the atoms consists what we call their heat. "What is heat in us," as Locke has perfectly expressed it, "is in the body heated nothing but motion." Well, we must figure this motion communicated to the medium in which the atoms swing, and sent in ripples through it with inconceivable velocity to the bounds of space. Motion in this form, unconnected with ordinary matter, but speeding through the interstellar medium, receives the name of radiant heat; and, if competent to excite the nerves of vision, we call it light.

Aqueous vapour was defined to be an invisible gas. Vapour was permitted to issue horizontally with considerable force from a tube connected with a small boiler. This track of the cloud of condensed steam was vividly illuminated by the electric light. What was seen, however, was not vapour, but vapour condensed to water. Beyond the visible end of the jet the cloud resolved itself into true vapour. A lamp was placed under the jet at various points; the cloud was cut sharply off at that point; and when the flame was placed near the efflux orifice, the cloud entirely disappeared. The heat of the lamp completely prevented precipitation. This same vapour was condensed and congealed on the surface of a vessel containing a freezing mixture, from which it was scraped in quantities sufficient to form a small snowball. The beam of the electric lamp, moreover, was sent through a large receiver placed on an air-pump. A single stroke of the pump caused the precipitation of the aqueous vapour within, which became beautifully illuminated by the beam; while, upon a screen behind, a richly-coloured halo due to diffraction by the little cloud within the receiver flashed forth.

The waves of heat speed from our earth through our atmosphere towards space. These waves dash in their passage against the atoms of oxygen and nitrogen, and against the molecules of aqueous vapour. Thinly scattered as these latter are, we might naturally think meanly of them as barriers to the waves of heat. We might imagine that the wide spaces between the vapour molecules would be an open door for the passage of the undulations; and that if those waves were at all intercepted, it would be by the substances which form 99½ per cent. of the whole atmosphere. Three or four years ago, however, it was found by the speaker that this small modicum of aqueous vapour intercepted fifteen times the quantity of heat stopped by the whole of the air in which it was diffused. It was afterwards found that the dry air then experimented with was not perfectly pure, and that the purer the air became the more it approached the character of a vacuum, and the greater, by comparison, became the action of the aqueous vapour. The vapour was found to act with 30, 40, 50, 60, 70 times the energy of the air in which it was diffused; and no doubt was entertained that the aqueous vapour of the air which filled the Royal Institution theatre during the delivery of the discourse absorbed 90 or 100 times the quantity of radiant heat which was absorbed by the main body of the air of the room.

Looking at the single atoms, for every 200 of oxygen and nitrogen there is about 1 of aqueous vapour. This 1, then, is 80 times more powerful than the 200; and hence, comparing a single atom of oxygen or nitrogen with a single atom of aqueous vapour, we may infer that the action of the latter is 16,000 times that of the former. This was a very astonishing result, and it naturally excited opposition, based on the philosophic reluctance to accept a result so grave in consequences before testing it to the uttermost. From such opposition a discovery, if it be worth the name, emerges with its fibre strengthened, as the human character gathers force from the healthy antagonisms of active life. It was urged that the result was, on the face of it, improbable; that there were, moreover, many ways of accounting for it without ascribing so enormous a comparative action to aqueous vapour. For example, the cylinder which contained the air in which these experiments were made was stopped at its ends by plates of rock-salt, on account of their transparency to radiant heat. Rock-salt is hygroscopic: it attracts the moisture of the atmosphere. Thus, a layer of brine readily forms on the surface of a plate of rock-salt; and it is well known that brine is very impervious to the rays of heat. Illuminating a polished

* A paper read at the Royal Institution.

plate of salt by the electric lamp, and casting, by means of a lens, a magnified image of the plate upon a screen, the speaker breathed through a tube for a moment on the salt; brilliant colours of thin plates (soap-bubble colours) flashed forth immediately upon the screen—these being caused by the film of moisture which overspread the salt. Such a film, it was contended, is formed when undried air is sent into the cylinder; it was, therefore, the absorption of a layer of brine which was measured, instead of the absorption of aqueous vapour.

This objection was met in two ways:—1st. By showing that the plates of salt when subjected to the strictest examination show no trace of a film of moisture. 2ndly. By abolishing the plates of salt altogether, and obtaining the same results in a cylinder open at both ends.

It was next surmised that the effect was due to the impurity of the London air, and the suspended carbon particles were pointed to as the cause of the opacity to radiant heat. This objection was met by bringing air from Hyde-park, Hampstead-heath, Primrose-hill, Epsom Downs, a field near Newport in the Isle of Wight, St. Catharine's Down, and the sea-beach near Black Gang Chine. The aqueous vapour of the air from these localities intercepted at least seventy times the amount of radiant heat absorbed by the air in which the vapour was diffused. Experiments made with smoky air proved that the suspended smoke of the atmosphere of West London, even when an east wind pours over it—the smoke of the city, exerts only a fraction of the destructive powers exercised by the transparent and impalpable aqueous vapour diffused in the air.

The cylinder which contained the air through which the calorific rays passed was polished within, and the rays which struck the interior surface were reflected from it to the thermo-electric pile which measured the radiation. The following objection was raised:—You permit moist air to enter your cylinder; a portion of this moisture is condensed as a liquid film upon the interior surface of your tube; its reflective power is thereby diminished; less heat therefore reaches the pile, and you incorrectly ascribe to the absorption of aqueous vapour an effect which is really due to diminished reflection of the interior surface of your cylinder.

But why should the aqueous vapour so condense? The tube within is warmer than the air without, and against its inner surface the rays of heat are impinging. There can be no tendency to condensation under such circumstances. Further, let five inches of undried air be sent into the tube—that is, one-sixth of the amount which it can contain. These five inches produce their proportionate absorption. The driest day on the driest portion of the earth's surface would make no approach to the dryness of our cylinder when it contains only five inches of air. Make it 10, 15, 20, 25, 30 inches: you obtain an absorption exactly proportional to the quantity of vapour present. It is next to a physical impossibility that this could be the case if the effect were due to condensation. But lest a doubt should linger in the mind, not only were the plates of rock-salt abolished, but the cylinder itself was dispensed with. Humid air was displaced by dry, and dry air by humid in the free atmosphere; the absorption of the aqueous vapour was here manifest, as in all the other cases.

No doubt, therefore, can exist of the extraordinary opacity of this substance to the rays of obscure heat, and particularly such rays as are emitted by the earth after it has been warmed by the sun. It is perfectly certain that more than 10 per cent. of the terrestrial radiation from the soil of England is stopped within ten feet of the surface of the soil. This one fact is sufficient to show the immense influence which this newly-discovered property of aqueous vapours must exert on the phenomena of meteorology.

This aqueous vapour is a blanket more necessary to the vegetable life of England than clothing is to man. Remove for a single summer night the aqueous vapour from the air which overspreads this country, and you would assuredly destroy every plant capable of being destroyed by a freezing temperature. The warmth of our fields and gardens would pour itself unrequited into space, and the sun would rise upon an island held fast in the iron grip of frost. The aqueous vapour constitutes a local dam, by which the temperature at the earth's surface is deepened; the dam, however, finally overflows, and we give to space all that we receive from the sun.

The sun raises the vapours of the equatorial ocean; they rise, but for a time a vapour screen spreads above and around them. But the higher they rise, the more they come into the presence of pure space; and when, by their levity, they have penetrated the vapour screen which lies close to the earth's surface what must occur?

It has been said that, compared atom for atom, the absorption of an atom of aqueous vapour is 16,000 times that of air. Now the power to absorb and the power to radiate are perfectly reciprocal and proportional. The atom of aqueous vapour will therefore radiate with 16,000 times the energy of an atom of air. Imagine, then, this powerful radiant in the presence of space, and with no screen above it to check its radiation. Into space it pours its heat, chills itself, condenses, and the tropical torrents are the consequence. The expansion of the air, no doubt, also refrigerates it; but in accounting for these deluges, the chilling of the vapour by its own radiation must play a most important part. The rain quits the ocean as vapour; it returns to it as water. How are the vast stores of heat set free by the change from the vaporous to the liquid condition disposed of? Doubtless in great part they are wasted by radiation into space. Similar remarks apply to the cumuli of our latitudes. The warmed air, charged with vapour, rises in columns, so as to penetrate the vapour screen which hugs the earth; in the presence of space the head of each pillar wastes its heat by radiation, condenses to a cumulus, which constitutes the visible capital of an invisible column of saturated air.

Numberless other meteorological phenomena receive their solution by reference to the radiant and absorbent properties of aqueous vapour. It is the absence of this screen, and the consequent copious waste of heat, that causes mountains to be so much chilled when the sun is withdrawn. Its absence in Central Asia renders the winter there almost unendurable; in Sahara the dryness of the air is sometimes such, that though during the day "the soil is fire and the wind is flame," the chill at night is painful to bear. In Australia also the thermometric range is enormous, on account of the absence of this qualifying agent. A clear day and a dry day, moreover, are very different if it is charged with aqueous vapour, and on such occasions great chilling cannot occur by terrestrial radiation. Sir John Leslie and others have been perplexed by the varying indications of their instruments on days equally bright; but all these anomalies are completely accounted for by reference to this newly-discovered property of transparent aqueous vapour. Its presence would check the earth's loss; its absence, without sensibly altering the transparency of the air, would open wide a door for the escape of the earth's heat into infinitude.

ANECDOTES OF THE TELEGRAPH.

READING BY SOUND.—The substitution of reading by sound, instead of by sight, is a matter of very great importance to the proprietors of telegraph companies as well as the public: to the former because it saves expense, and to the latter because it ensures greater safety; and, finally, to both for the same reasons, for the interests of the proprietors and the public are very closely connected. We shall not pretend to say to whom is entitled the credit of having first discovered the idea of reading by sound; and if we could it would be a matter of no importance, for no one with a good idea of time could be within hearing of a Morse register a day without being aware of its peculiar adaptedness for this use. The first time, however, we saw any one read in this manner was in the winter of 1846-7 in New York. The lines were broken, and Mr. O. E. Wood and ourself were sent out to repair them. Mr. Wood carried a small electro-magnet in his hand, and when we reached Harlem-bridge he disconnected the line-wire, and attached it to one end of the helix-wire, and then, uncoiling a dozen or two feet of iron wire, dropped one end of it in the river, and with the other commenced tapping upon the other extremity of the helix-wire. To our infinite astonishment we saw the lever fly backward and forward, and presently, when he had stopped writing, he received a reply from the office in New York. He gave us the questions and answers as he received and sent them; and, although we have a thousand times since accomplished the same feat, the conversation and the occurrence are still indelibly fixed in our memory. No trick of legerdemain performed by the most successful necromancer has ever been able to excite so much interest in our mind as this.

READING BY SHOCKS.—There is, however, still another mode of receiving intelligence in connection with the Morse lines besides those already described—namely, by means of the passage of shocks through the system. This, we presume, has often been accomplished by different persons, although we have not been knowing to the fact. Mr. Milliken, of the American Telegraph-office in Boston, assures us that he once read the greater part of a despatch as it was passing over the wires between Boston and Portland, and that he heard the Portland operator respond "O K" (all right) to

it, while he was seated upon the draw at Mystic River-bridge, and held the end of a wire in each hand, thus passing the current through his body, and enabling them to read the letters by the duration and number of the shocks which he received. We have succeeded upon several occasions in receiving messages in this manner when we have been at a distance from an office, and wished to obtain information in regard to the state of the line. Not long since we had been annoyed upon one of our wires by a very bad earth-current, and none of the repairers being able to find the difficulty, we instituted a search for it. Finally, upon arriving at Nepouset, we opened the circuit at the draw, and inquired of the Boston operator, by touching the ends of the wire together in the proper time, if the earth-current was between us and the Boston office, or beyond. This he would at once tell by my opening the circuit—disconnecting the wires; if he got any magnetism when the wires were disconnected, then the earth-current was between us and the office; if he got none, then the trouble was beyond. This was important for us to know. He replied that he did get an earth-current when we opened the circuit. We asked if it was very strong. "Yes," he replied, "nearly as strong as when you close." All this, the reader will understand, we received through our system, and interpreted by the duration and number of the shocks. "There is trouble also upon the New Bedford wire," said he; "I have not had any circuit for nearly half-an-hour." We then sent an order for a line repairer to go out at once and repair that line, and then recommenced our investigations into the location of the earth-current, which we shortly afterwards succeeded in finding.

Spiritual Interruptions!—We have previously mentioned that the earth serves as a return wire. The earth, in fact, from its immense conducting surface, constitutes the best conductor—better than all minerals, for its resistance to the passage of an electric current has been found to be null. It being the same thing, in fact, to put the two ends of the wire into connection with the earth as to bring them together. This, as may be imagined, is of vast importance in the economy of working telegraph lines, as one wire in every circuit is thus saved; but there are sometimes very provoking consequences resulting from this cause—namely, the loss of current by earth circuit or "escape." An occurrence of this kind happened upon the line between Boston and Salem some months since, which baffled for weeks the most careful research of experienced repairers. The earth current came on at precisely seven o'clock p.m., and was off at the commencement of business in the morning; therefore, there was only from seven p.m. to eight a.m. when there was any opportunity of finding it. Five men were despatched over the road every day with strict injunctions to watch every inch of the wire, but still they reported that nothing could be found. It looked mysterious. Had the spirits anything to do with it? They had never yet troubled the telegraph, but there must be a beginning for all things—was this the beginning? We strongly suspected that it was. One afternoon we went to Salem ourself, and remained in the office from half-past six to seven o'clock. We would see if it would come on while we were there. Seven o'clock arrived, no earth-current; one minute past, none; three, none. We began to feel encouraged; perhaps it had "played out." The train left at 7.15; we hoped to leave in that, with the knowledge that all was right—7.4, no earth-current; 7.5, it is on again. We were in for it, and we immediately started for a personal solution of the difficulty. Upon walking down the track a few rods we found the "spirit" in the shape of an iron switch-rod, which had been put up about four weeks before to switch off the Marblehead track at seven o'clock every morning, and *which was switched on at precisely seven o'clock each afternoon.* Upon this occasion the switchman had been five minutes late. He said he noticed when he switched it on that it touched the wires, but he did not know that it would do any damage, as it was only iron. Thus ended our first assault upon the spirits.—*Prescott.*

Six Bell-Ringers Killed by Lightning.—A few days ago, says a Tyrolese paper, a thunderstorm discharged its fury on the village of Worgel, in the Valley of the Inn. True sons of the holy church, the villagers at once flocked to the steeple to attract their saint's attention by ringing the bells; and this the more readily as they had the good luck of numbering among them a bell reported miraculous, and which had been long renowned for its efficacy in case of danger from fire or water. But the laws of Nature do not always agree with the superstitions of the church. The electric fluid being attracted by the huge piece of metal swaying to and fro, the lightning came down upon the ringers, and killed six of them on the spot.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

VII.

A.D. 1816.—Mr. F. Ronalds invented his electric telegraph in 1816. Tension electricity was employed. "The wires used were laid under-ground as well as suspended in the air. A pith-ball electrometer, hung before a clock movement, enabled the letters on a dial to be read off." (See Highton's *Electric Telegraph*, p. 39.)

A.D. 1818.—Dr. A. Ure, in 1818, submitted the body of a man who had been hanged, immediately after the execution, to the action of a galvanic battery of 270 pairs of copper and zinc plates. One of the electrodes was, by means of an incision, placed in contact with the spinal marrow, whilst the other was applied to the sciatic nerve, which had also been laid bare. Immediately all the limbs of the body were agitated by convulsive movements, and a wonderful likeness to the actions of various organs of the body in life was produced, much to the terror of the spectators. (See De la Rive's *Treatise on Electricity*, Vol. II., pp. 489, 490; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 197.)

A.D. 1819.—Professor Oersted, of Copenhagen, in a work published in 1807, proposed "to try whether electricity, in its latent state, will not affect the magnetic needle;" and, at the close of the year 1819, he found that, "that end of the needle which is situated next to the negative side of the" [galvanic?] "battery, or towards which the current of positive electricity is flowing, immediately moves to the westward." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 1; also *Library of Useful Knowledge*, Electro-magnetism, p. 4.)

A.D. 1819.—Hare's "calorimotor" was constructed in 1819. In this galvanic battery the zinc plates were in flat copper cases. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 222; also Gmelin's *Handbook of Chemistry*, Vol. I., pp. 409, 410.)

A.D. 1820.—M. Ampère, at a meeting of the Royal Academy on September 18, 1820, proved that the voltaic pile itself acted in the same manner on the magnetic needle as the connecting wire, and produced to the meeting a "galvanometer." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 5.)

A.D. 1820.—M. Ampère, on September 25, 1820, announced the "fact of the attraction and repulsion of two wires connecting the poles of a" [galvanic?] "battery; and showed that the magnetic needle which had previously been used to prove the magnetic attractions and repulsions of the wire, could be replaced by another connecting wire like the first." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 5.)

A.D. 1820.—M. Arago, on September 25, 1820, "stated to the Royal Academy of Sciences that he had ascertained the attraction of iron filings by the connecting wire of the" [galvanic?] "battery, exactly as by a magnet." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 6.)

A.D. 1820.—M. Arago, about the end of September, 1820, magnetized a sewing-needle permanently by the galvanic current. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 6.)

A.D. 1820.—M. Ampère, in September, 1820, found a spiral or helical arrangement of the galvanic conducting-wire most advantageous in magnetizing needles. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 6.)

A.D. 1820.—M. Boisgeraud, on October 9, 1820, read a paper to the Royal Academie of Sciences, in which he proposed to ascertain the conducting power of different substances by placing them in the galvanic circuit, together with Ampère's galvanometer. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 6.)

A.D. 1820.—M. Ampère, on October 30, 1820, read an account to the Royal Academy of his method of proving the action of terrestrial magnetism upon galvanic currents. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 7.)

A.D. 1820.—MM. Biot and Savart, on October 30, 1820, read a memoir to the Academy of Sciences, in which it was demonstrated by oscillations of the magnetic needle, that the action of a galvanic conducting-wire upon it (the needle) was "in the inverse ratio of the simple distance." (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, pp. 4 and 7.)

A.D. 1820.—M. Arago, on November 6, 1820, announced that common or static electricity produced the same effects in magnetizing iron and steel as voltaic electricity. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 7.)

A.D. 1820.—Ampère, on November 6, 1820, perfectly imitated a magnet by a helical galvanic conducting wire. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, pp. 7, 8.)

A.D. 1820.—Schweigger, in 1820, invented his galvanometer. (See *Encyclopædia Britannica*, 7th edition, art. Voltaic Electricity, p. 687.)

A.D. 1820.—Sir Humphrey Davy, about the close of the year 1820, caused the rotation of an arc of electric light, by the proximity of the poles of a powerful permanent magnet. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, pp. 9, 10.)

A.D. 1820.—Ampère invented his telegraphic arrangement in 1820: He "employed the magnetic needle, the coil of wire, and the galvanic battery, and proposed the use of as many wires as letters or signals to be indicated." (See Highton's *Electric Telegraph*, p. 39.)

A.D. 1820.—Sir William Snow Harris, in 1820, supplied sea-going vessels with lightning-conductors. (See *Encyclopædia Britannica*, 8th edition, art. Electricity, p. 610.)

A.D. 1820.—Bohnenberger, in 1820, invented his electroscope. This instrument consists of a gold leaf suspended between the opposite poles of two dry piles; it is thus made not only to show the presence, but also the kind of electricity possessed or developed by the body under examination, and is extremely sensitive in its indications. (See Noad's *Manual of Electricity*, p. 30; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 54-56.)

A.D. 1821.—Faraday, in 1821, discovered the electro-magnetic rotative force developed in a magnet by a wire-conducting galvanic electricity, and in a conducting wire by a magnet. He also demonstrated the ability of terrestrial magnetism to rotate a conducting wire. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 12.)

A.D. 1821.—Professor Cumming, in April, 1821, invented a galvanometer in which a conducting wire was disposed in a circle or square of two or more coils, and the terrestrial direction of the needle (placed within the coils) was neutralized. In certain experiments he found the tangent of a needle's deviation varied inversely as the distance of the conducting wire from the magnetic needle; also that, when the battery plates were placed at different distances from one another, the "tangent of deviation varied inversely as the square root of the distances of the plates." Professor Cumming, with the assistance of Dr. Clarke and Mr. Lunn, produced "electro-magnetic effects from the electricity of the atmosphere, by the usual apparatus, an electrical kite." (See the *Transactions of the Cambridge Philosophical Society*, 1821; also *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, pp. 14, 15.)

A.D. 1821.—Hare's "deflagrator" was constructed in 1821. This galvanic arrangement consisted of eighty coils of zinc and copper plates immersed in eighty separate vessels. (See *Encyclopedia Metropolitana*, Vol. IV., art. Galvanism, pp. 176 and 222; also Gmelin's *Handbook of Chemistry*, Vol. I., pp. 409, 410.)

A.D. 1823.—M. Seebeck discovered thermo-electricity in 1823. His first experiment was as follows:—A kind of arc was made of a plate of copper soldered to a bar of bismuth, in the interior of which a magnetic needle was pivoted; a deflection of the needle was produced by heating either of the soldered junctions. (See De la Rive's *Treatise on Electricity*, Vol. II., p. 535.)

A.D. 1823.—Professor Cumming, in 1823, ascertained that the unequal distribution of heat was the cause of thermo-electricity, and made a table of positive and negative thermo-electrics. About this period Van Zuylen, Dr. Van Beek, and Professor Moll, of Utrecht, extended Seebeck's experiments. (See *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, pp. 20-26; also the *Transactions of the Cambridge Philosophical Society*, 1823.

A.D. 1823.—Pepys, in 1823, constructed the galvanic battery for the London Institution. It was formed of a single pair of plates (copper and zinc), coiled like a double ribbon round a wooden cylinder, and prevented from coming into contact by means of horsehair ropes. (See *Practical Mechanic and Engineer's Magazine*, February, 1842, p. 191; also *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, pp. 176 and 222.)

A.D. 1824.—Sir Humphrey Davy, in 1824, applied the principles of galvanic electricity to prevent the corrosion of the copper sheathing of ships by sea-water. Strips of zinc were affixed to the copper sheathing for this purpose; the copper was thereby protected at the expense of the zinc, but, in practice, sea-weed and shell-fish were found to adhere to the protected surface. (See *Encyclopædia Metropolitana*, Vol. IV., art. Galvanism, p. 222; also Bakewell's *Electric Science*, p. 35.)

A.D. 1824.—De la Rive described the sine galvanometer in 1824. (See De la Rive's *Treatise on Electricity*, Vol. I., p. 334.)

A.D. 1824.—Professor Barlow, in 1824, established the fact that the galvanic fluid in a conducting wire acts on the magnetic fluid in a magnetized needle with a force varying inversely as the square of the distance. He also proved that magnetic poles tend to place themselves at right angles to electric poles, and *vice versâ*, by the action of a tangential force. (See *An Essay on Magnetic Attractions*, 2nd edition, 1824; also *Encyclopædia Metropolitana*, Vol. IV., art. Electro-magnetism, p. 15.)

A.D. 1826.—Pohl, about the year 1826, made the following galvanic arrangement:—"One zinc and seven copper plates are separated from one another by seven layers of a moist conductor which does not surround them, but merely touches their surfaces." The zinc at one end is connected by a metallic arc with the copper, No. 7, at the opposite end; No. 1 copper plate is similarly connected with No. 6; No. 2 with No. 5; and No. 3 with No. 4. "An electric current, sensible to an interposed galvanometer, goes through all the arcs, through the first and third in one direction, through the second and forth in the opposite direction. The current in the first arc is the strongest, that of the second weaker, and that of the fourth weakest of all." (See Gmelin's *Handbook of Chemistry*, Vol. I., p. 408.)

A.D. 1826.—Sir Humphrey Davy, in his Bakerian Lecture in 1826, stated that "zinc in amalgamation with mercury is positive with respect to pure zinc" in a galvanic arrangement. (See Sturgeon's *Annals of Electricity, Magnetism, and Chemistry*, Vol. I., January, 1837, p. 81.)

A.D. 1826.—M. Leopold Nobili, of Reggio, in the year 1826, discovered metallo-chromy. This phenomenon is known by the name of "Nobilli's rings," and is produced by the electrolysis of a solution of acetate of lead, using a platinum plate as a positive pole and a platinum wire as a negative pole. The deposit takes place on the positive plate, and consists of concentric coloured rings of peroxide of lead. Mr. Gassiot used for this experiment a perforated card placed over a polished steel positive plate, and a negative plate of copper covering the whole. (See Sturgeon's *Lectures on Galvanism*, pp. 197, 198.)

A.D. 1827.—Ohm, in 1827, put forward the following celebrated formulæ relating to the *quantity* of the galvanic current:—"1. *For a conductor into whose extremities the two electricities flow with a given tension:* Let A be the electrical tension; K the conducting power of the wire or other conductor; *w* the surface of its transverse section; L its length; Q the quantity of current; then $Q=\frac{AKw}{L}$." "2. *For a simple galvanic circuit:* Let A be the electro-motive power of the circuit (or the tension?), R the resistance which the current meets with in the circuit itself. This is the resultant of the following individual resistances:—*a.* Resistance of the two metallic plates which the current has to traverse;—*b.* Resistance of the liquid through which, according to the ordinary view, the current passes." "To this Fechner and Poggendorff add *c*, the resistance of transition,—*i.e.* the resistance which exists to the passage of the electric current from the metal to the liquid, and conversely. Also let *r* be the resistance of the conductor which unites the two metals, and Q the quantity of the electric current which enters it; then $Q=\frac{A}{R+r}$; therefore $A = Q\,(R + r)$." "3. *For the galvanic battery: n* denoting the number of united simple circuits, $Q=\frac{nA}{nR+r}$." (See Gmelin's *Handbook of Chemistry*, Vol. I., pp. 414, 415.)

A.D. 1827.—M. Savary, in 1827, pointed out that the intensity, and even the direction, of the magnetization produced upon a steel needle by a discharge of fractional electricity transmitted through a rectilinear wire, depends upon the distance of the needle from this wire; also that the magnetic intensity does not diminish as the distance from the wire increases, but there are points of maximum and minimum intensity. He produced similar results by discharges of successively increasing intensity through a helix. M. Savary found that insulated conducting (but non-magnetic) envelopes to the needle, placed within the helix and insulated from it, diminished the magnetizing power of the helix. (See De la Rive's *Treatise on Electricity*, Vol. I., pp. 281-287, also Vol. II., p. 889.)

A.D. 1827.—Sir William Snow Harris, in 1827, invented the thermo-electrometer. (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 89.)

A.D. 1828.—Mr. Kemp, in 1828, employed fluid amalgam of zinc in galvanic batteries. (See Sturgeon's *Annals of Electricity, Magnetism, and Chemistry*, Vol. I., January, 1837, pp. 81-88.)

A.D. 1828.—Dr. Farré Palaprat, in 1828, published a translation of a work of Labaume. The medical effects of electricity are

brought about in this instance by galvanism. Dr. Fabré Palaprat "employed a platinum wire heated by a voltaic battery, in order to produce moxas." (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 589 and 687.)

A.D. 1828.—Mr. Green, in a work published in 1828, investigated the subject of the distribution of electricity, mathematically, and proved that an infinite number of forms of conductors may be invented so that the distribution of electricity in equilibrium may be expressed in finite algebraic terms. (See *Encyclopædia Britannica*, 8th edition, art. Electricity, pp. 533, 534.)

A.D. 1828.—Tribaoillet, in 1828, invented his electric telegraph; it "required but one wire, and this was buried in the earth. A galvanic battery and a galvanoscope were employed." (See Highton's *Electric Telegraph*, p. 39.)

A.D. 1829.—Becquerel, in 1829, made public a double-fluid galvanic battery, consisting of copper, a salt of copper, dilute sulphuric acid or sulphate of zinc, and zinc. (See *Practical Mechanic and Engineers' Magazine*, September, 1842, p. 484.)

A.D. 1829.—Becquerel, in 1829, used membranous diaphragms in voltaic batteries. He also used porcelain clay, wetted with a solution of sea-salt, and plaster of Paris. (See *Practical Mechanic and Engineers' Magazine*, November, 1842, p. 43.)

A.D. 1830.—Mr. Sturgeon, in 1830, published his method of using amalgamated rolled zinc plates as positive plates in galvanic batteries. His cast-iron single-fluid galvanic battery was invented about this time. (See Sturgeon's *Lectures on Galvanism*, pp. 135-137.)

A.D. 1830.—Mr. Fox, of Falmouth, in 1830, published his researches respecting the electricity of metalliferous veins. (See *Philosophical Transactions*, 1830, p. 399.)

A.D. 1830.—Dr. Ritchie, in 1830, put forward his torsion galvanometer. (See *Encyclopædia Britannica*, 7th edition, art. Voltaic Electricity, p. 688.)

A.D. 1830.—M. Rayer "introduced, since 1830, during his service at the Hospital of Charity, a trough" [galvanic?] "battery, and made it serve in the treatment of all kinds of paralysis." (See De la Rive's *Treatise on Electricity*, Vol. III., p. 592.)

A.D. 1831.—Dr. Faraday, in 1831, produced an electric spark by the sudden separation of a coiled keeper from a permanent magnet. He also, in 1831, found an electric current to exist in a copper plate rotated between the poles of a magnet. (See Bakewell's *Electric Science*, pp. 39, and 140, 141.)

A.D. 1831.—MM. Andral and Ratier, in 1831, published an article in the Dictionary of Medicine and Practical Surgery which gives a summary of the work of M. Andrieux on medical electricity. The various kinds of electricity are herein proposed as extremely powerful physical agents. (See De la Rive's *Treatise on Electricity*, Vol III., pp. 591, 592.)

A.D. 1831.—Dr. Faraday, in 1831, discovered the existence of the electric current induced in a hollow coil of wire when a steel permanent magnet is introduced into or withdrawn from the coil. An electro-magnet was afterwards substituted for the permanent magnet with even greater success. (See Bakewell's *Electric Science*, p. 39.)

A.D. 1831.—Professor Henry, of Princeton, United States, in 1831, suggested the application of electro-magnetic force to motive power. (See *Encyclopædia Britannica*, 7th. edition, art. Voltaic Electricity, p. 687.)

A.D. 1832.—Schilling invented his electric telegraph in 1832. He "employed five magnetic needles and had also a mechanical alarum." In another telegraph he only used one wire and one needle. (See Highton's *Electric Telegraph*, p. 39.)

A.D. 1832.—Schilling, in 1832, placed the telegraph magnetic needles vertical. (See Highton's *Electric Telegraph*, p. 137.)

A.D. 1832.—Schilling, in 1832, used a weight, which was caused to fall by a current of electricity, to sound a bell. (See Highton's *Electric Telegraph*, p. 137.)

A.D. 1832.—Dr. Botto, of Turin, in 1832, made a thermo-electric battery of platinum and iron. (See Noad's *Lectures on Electricity*, p. 426.)

A.D. 1832.—M. Pixii, in 1832, constructed his magneto-electric machine. In this arrangement a horseshoe permanent magnet rotated in front of a coiled keeper. (See Highton's *Electric Telegraph*, p. 17; also De la Rive's *Treatise on Electricity*, Vol. I., p. 373.)

A.D. 1832.—Salvator Dal Negro, in November, 1832, published a paper in which he explained the method adopted by him of applying electro-magnetism to move machines. (See *Practical Mechanic and Engineers' Magazine*, November, 1842, p. 48.)

ON BOILING WATER.

By W. Grove, Esq., Q.C., F.R.S., M.R.I.

A paper by M. Donny (*Mémoires de l'Académie Royale de Bruxelles*, 1843,) makes known the fact that in proportion as water is deprived of air, the character of its ebullition changes, becoming more and more abrupt, and boiling like sulphuric acid with *soubresauts*, and that between each burst of vapour the water reaches a temperature above its boiling point. To effect this, it is necessary that the water be boiled in a tube with a narrow orifice, through which the vapour issues; if it be boiled in an open vessel it continually re-absorbs air and boils in the ordinary way.

In my experiments on the decomposition of water by heat, I found that with the oxyhydrogen gas given off from ignited platinum plunged into water, there was always a greater or less quantity of nitrogen mixed; this I could never entirely get rid of, and was thus led into a more careful examination of the phenomenon of boiling water, and set before myself this problem—what will be the effect of heat on water, perfectly deprived of air or gas?

Two copper wires were placed parallel to each other through the neck of a Florence cask, so as nearly to touch the bottom; joining the lower ends of these was a fine platinum wire, about an inch and a-half long, and bent horizontally into a curve. Distilled water, which had been well boiled and cooled under the receiver of an air-pump, was poured into this flask so as to fill about one-fourth of its capacity. It was then placed under the receiver of an air-pump, and one of the copper wires brought in contact with a metallic plate covering the receiver, the other bent backwards over the neck of the flask and its ends made to rest on the pump-plate. By this means, when the terminal wires from a voltaic battery were made to touch the one, the upper and the other lower plate, the platinum wire would be heated, and the boiling continued indefinitely in the vacuum of a very excellent air-pump. The effect was very curious. The water did not boil in the ordinary manner, but at intervals a burst of vapour took place, dashing the water against the sides of the flask, some escaping into the receiver. (There was a projection at the central orifice of the pump-plate to prevent this overflow getting into the exhaustion tube.)

After each sudden burst of vapour, the water became perfectly tranquil, without a symptom of ebullition until the next burst took place. These sudden bursts occurred at measured intervals, so nearly equal in time that, had it not been for the escape from the flask at each burst of a certain portion of water, the apparatus might have served as a time-piece.

This experiment, though instructive, did not definitely answer the question I had proposed, as I could not, of course, ascertain whether there was some minute residuum of gas which would form the nucleus of each ebullition, and I proceeded with others. A tube of glass, 5 feet long and $\frac{1}{10}$ths of an inch internal diameter, was bent into a V-shape; into one end a loop of platinum wire was hermetically sealed with great care, and the portion of it in the interior of the tube was platinized. When the tube had been washed, distilled water, which had been well purged of air as before, was poured into it to the depth of 8 inches, and the rest of the tube filled with olive oil; when the V was inverted, the open end of the tube was placed in a vessel of olive oil, so that there would be 8 inches of water resting on the platinum wire, separated from the external air by a column of 4 feet 4 inches of oil. The projecting extremities of the platinum wire were now connected with the terminals of a voltaic battery, and the water heated; some air was freed, and ascended to the level of the tube—this was made to escape by carefully inverting the tube so as not to let the oil mix with the water—and the experiment continued. After a certain time the boiling assumed a uniform character, not by such sudden bursts as in the Florence flask experiment, but with larger and more distinct bursts of ebullition than in its first boiling.

The object of platinizing the wire was to present more points for the ebullition, and to prevent *soubresauts* as much as possible.

The experiment was continued for many hours, and, in some repetitions of it, for days. After the boiling had assumed a uniform character, the progress of the vapour was carefully watched, and as each burst of vapour condensed in the oil, which was kept cool, it left a minute bead of gas, ascending through the oil to the bend of the tube: a bubble was formed here which did not seem at all absorbed by the oil. This was analysed by a eudiometer, which I will presently describe, and proved to be nitrogen. The beads of gas, when viewed through a lens and micrometer scale at the same

height in the tube, appeared as nearly as may be of the same size. No bubble of vapour was condensed completely, or without leaving this residual bubble. The experiment was frequently repeated, and continued until the water was so nearly boiled away that the oil, when disturbed by the boiling, nearly touched the platinum wire; here it was necessarily stopped.

To avoid any question about the boiling being by electrical means, similar experiments were made with a tube, without a platinum wire, closed at its extremity, and the boiling was produced by a spirit lamp. The effects were the same, but the experiment was more difficult and imperfect, as the bursts of vapour were more sudden, and the duration of the intervals more irregular.

The beads of gas were extremely minute, just visible to the naked eye, but were made visible to the audience by means of the electric light.

In these experiments there was no pure boiling of water—*i.e*, no rupture of cohesion of the molecules of water itself, but the boiled, to use M. Donny's expression, by evaporation against a surface of gas.

It is hardly conceivable that air could penetrate through such a column of oil, the more so as the oil did not perceptibly absorb the nitrogen freed by the boiling water and resting in the bend of the tube. But to meet this conjectural difficulty, the following experiment was made:—A tube, 1 foot long and $\frac{3}{10}$ths of an inch internal diameter, bent into a slight angle, had a bulb three-quarters of an inch diameter, blown on it at the angle. This angle was about three inches from one end, and nine from the other. A loop of platinum wire was sealed into the shorter leg, and the whole tube and bulb filled with and immersed into mercury; water distilled, and purged of air, as before, was allowed to fill the short leg, and by carefully adjusting the inclination, the water could be boiled so as to allow bubbles to ascend into the bulb and displace the mercury. The effect was the same as with the oil experiment—no ebullition, without leaving a bead of gas; the gas collected in the bulb, and was cut off by what may be termed a valve of mercury from the boiling water, then allowed to escape, and so on. The experiment was continued for many days, and the bubbles analysed from time to time. They proved, as before, to be nitrogen, and, as before, continued indefinitely.

A similar experiment was made without the platinum wire, and though, from the greater difficulties, the experiment was not so satisfactory, the result was the same.

As the mercury of the common barometer will keep air out of its vacuum for years, if not for centuries, there could be no absorption here from the external atmosphere, and I think I am fairly entitled to conclude from the above experiments—which I believe went far beyond any that have been recorded—that no one has yet seen the phenomenon of pure water boiling, *i.e.*, of the disruption of the liquid particles of the oxyhydrogen compound so as to produce vapour which will, when condensed, become water, leaving no permanent gas. Possibly, in my experiment of the decomposition of water by ignited platinum, it may be that the sudden application of intense heat, and in some quantity, so forces asunder the molecules, that, not having sufficient nitrogen dissolved to supply them with a nucleus for evaporation, the integral molecules are severed, and the decomposition takes place. If this be so, and it seems to me by no means a far-fetched theory, there is probably no such thing as boiling, properly so called, and the effect of heat on liquid in which there is no dissolved gas may be to decompose them.

Considerations such as these led me to try the effect of boiling on an elementary liquid, and bromine occurred as the most promising one to work upon. As bromine could not be boiled in contact with water, oil, or mercury, the following plan was ultimately devised:—A tube, 4 feet long and $\frac{4}{10}$ths of an inch diameter, had a platinum loop sealed into one closed extremity; bromine was poured into the tube to the height of four inches; the open end of the tube was then drawn out to a fine point by the blow-pipe. leaving a small orifice; the bromine was then heated by a spirit-lamp, and when all the air was expelled, and a jet of bromine vapour issued from the point of the tube, it was sealed by the blow-pipe. There was then, when the bromine vapour had condensed, a vacuum in the tube above the bromine. The platinum loop was now heated by a voltaic battery, and the bromine boiled; this was continued for some time, care being taken that the boiling should not be too violent. At the end of a certain period—from half-an-hour to an hour—the platinum loop gave way, being corroded by the bromine; the quantity of this had slightly decreased. On breaking off, under water, the point of the tube, the water mounted, and showed a notable quantity of permanent gas, which on analysis proved to be pure oxygen. As much as a quarter of a cubic inch was collected at one experiment. The platinum wire which had severed at the middle, was covered with a slight black crust, which, suspecting it to be carbon, I ignited by a voltaic spark in oxygen, in a small tube over lime-water; it seemed to give a slight opalescence to the liquid, but the quantity was so small that the experiment was not relied on. No definite change was perceptible in the bromine; it seemed to be a little darker in colour, and had a few black specks floating in it, which I judged to be minute portions of the same crust which had formed on the platinum wire, and which had become detached.

The experiment was repeated with chloride of iodine, and with the same result, except that the quantity of oxygen was greater. I collected as much as half a cubic inch in some experiments, from an equal quantity of chloride of iodine; the platinum wire, however, was more quickly acted on than with bromine, and the glass of the tube around it to some extent.

Melted phosphorus was exposed to the heat of the voltaic disruptive discharge by taking this between platinum points in a tube of phosphorus, similarly to an experiment of Davy's, but with better means of experimenting. A considerable quantity of phosphuretted hydrogen was given off, amounting, in several experiments, to more than a cubic inch.

(To be continued.)

THE PROGRESS OF DISCOVERY.

NOT only do things mend when they get to the worst, but they sometimes break down when they get to the best. Mediæval philosophers had just demonstrated, with the very perfection of such logic as the schools possessed, that the earth was the centre of the universe, when Copernicus suggested a disagreeable truth, and Galileo came forward with his far-reaching tube to make that truth visible. The new philosophy was stoutly resisted, but it prevailed at last, and the Ptolemaic heavens "passed away." No doubt bows and arrows were wonderfully perfected by the time gunpowder was introduced; and most likely catapults and battering-rams were vastly improved just before the voice of the cannon was heard. Coming down to our own days, how proud we were of our turnpike roads and mail coaches, just when the shriek of the locomotive began to wake up the echoes of our mining districts. Our stage coaches had become elegant, our coachmen and guards were public pets, and the spanking team was the wonder of the villagers and the grand sight of the market town; when suddenly there came in view the roaring locomotive, the terror of the timid, and the detestation of all who loved the road. MacAdam had levelled our highways, and our horses were doing their work splendidly—the world had never seen such vehicles or such charioteers—when the steam cloud came and overshadowed all the glory, till the roads were deserted, the inns shut up, and the coachman compelled to come down from his box. So has it been again and again in the history of human inventions and institutions. The thing is just perfected when it has to be thrown aside. The house is just built when it has to be razed to its foundations. We sit down by the roadside and think our journey is done, when we have to rise up again and renew the race. We perfect some warlike arm, and it is superseded by another. We build a fleet, and forthwith we find it useless. We build again, with the like fate, until at last our dockyards become little else than depôts for old and useless structures. "Out of date" is written upon countless efforts of the human mind, and "Ichabod" could scarcely convey the idea of greater desertion.

The waggon superseded the pack-horse, the coach to a great extent superseded the waggon, the railway has eclipsed them all; and is it possible that something shall outshine the railway? Will the steam horse and the accompanying train ever be looked upon as antiquated and obsolete, like long-bows, matchlocks, and three-deckers? The realisation of such an idea seems impossible. But who thought of steam ships in the days of Nelson, and where was the electric telegraph forty years ago? Locomotives may, indeed, go down to the last days, for all we know; but science is a progressive thing, and the scene perpetually changes as the years roll on. Railways are supreme just now, as stage coaches once were. Opposition has been threatened in the shape of balloons, but the railway share market is insensible to the danger. Perhaps the railway, in some form or other, will be a perpetual institution. It is more easy to conceive this to be the case than the contrary. We can understand that the art of printing may be modified, but we can scarcely apprehend it possible for some new discovery—some hitherto unheard-of invention—to arise and confound the printer's devil by entirely sweeping away the art to which he is apprenticed. So with the railway—it may be modified, yet remain. Some signs of this already appear. Our engineers have of late been applying the principle of the popgun and the air-pump to the transit of certain mail-bags, placed in a suitable carriage on the rails of a tubular subterranean railway. More recently the ingenious individuals connected with the Pneumatic Dispatch Company have become ambitious of conveying passengers in like manner. One or two adventurous beings have even allowed themselves to be shot

through the Post-office tube; but at the present time it is quite possible to test the atmospheric system in a more agreeable and formal manner. Mr. Rammell, the inventor of the pneumatic dispatch scheme, has applied his principle to the propulsion of a full-sized passenger carriage, in a tunnel constructed for the purpose in the grounds of the Crystal Palace Company. Steam power, exercised by a fixed engine, exhausts the air, or forces it into the tube, as may be requisite, and the carriage—attached to a proper disc, and travelling within the tube—is either sucked or blown along, accordingly as it goes one way or the other. Seemingly a very moderate power is sufficient for this purpose, and so far as the mechanical practicability is concerned Mr. Rammell's plan seems to be a great improvement on that which was tried some years ago by Messrs. Clegg & Samuda, on the London and Croydon Railway. Propulsion of this kind is now actually accomplished, steep gradients have been surmounted, sharp curves have been traversed, and curious visitors have personally tested this novel mode of travelling.—*Morning Herald.*

CAPTAIN SELWYN'S METHOD OF LAYING SUBMARINE CABLES.

THE following letter has been addressed to Captain Selwyn by Captain Tribe, a gentleman who has had considerable experience in the submersion and raising of submarine telegraph cables :—

Dear Sir,—I have, with care and interest, read over your pamphlets upon the "Use of Cylinders in laying Submarine Telegraphic Cables in Deep Seas." As I have been engaged with submarine cables for the last few years, and have had some experience in towing at sea, I feel happy in contributing my small share of testimony in favour of an object which, I have every reason to believe, will become of valuable importance. * * * * I have, therefore, no hesitation in giving my cordial support for the adoption of the cylinder to lay telegraph cables, as I really and truly believe that it is *the* method, and the only *honestly safe* method, for laying cables; and this opinion, I feel confident, would be verified if gentlemen interested in submarine telegraphy would but give an experimental trial of the cylinder, by having one made, and on it coiled some old iron-wire rigging, to be paid out in the Bay of Biscay, or off the bank of soundings, at the chops of the Channel. Before concluding these few of many remarks that could be brought to bear upon this subject, I will show the great saving that would result from the use of the cylinder. In a ship—you must have one built for the purpose, or go to the tremendous expense of having her holds fitted for the reception of the cable coils, by removing stanchions and beams, building tanks for the cable to be coiled in for constant testing (and woe betide these when rolling heavily in a gale of wind)—the decks are ruined by being cut up for heavy paying out machinery, the wear and tear of which can only be known by experience (inquire of the officers of the Agamemnon). Then there is the heating of the hold, the chances of damage to cable in coiling and uncoiling, the chances of cable shifting when the vessel rolls heavily, straining her fore and aft, and accidents, whether purely so or malicious. Treble the crew, the wages and provisions; and what with the changes of coils from forward to aft, and gun-deck to orlop, the constant change of watches for the men, and a thousand other incidents too many to be enumerated, but still existing, there is a combination of anxieties which must ever attend the responsible parties entrusted with the paying out a cable from a ship. With the cylinder, the first expense is the only great one; though that is only one-fourth of what a ship would cost; and when once fairly started with the cable, testing satisfactorily from end to end, come fair weather or foul, you have your ship free, your cable on a vessel that will never strain it, nor founder with it; there will be no shifting, no accidents, no fear of too much brake power, and no heart-wearing anxieties that *must* exist when the cable is inside the ship instead of out. I will now conclude, by wishing you heartily every success; and if I am permitted to witness its trial on the broad Atlantic, I feel certain I shall have the pleasure of congratulating you on your triumph; but on the sea, it (the cylinder work) *must* be consigned to your management, assisted by nautical men, and *not* to civil engineers and electricians, who will have quite sufficient to occupy their minds and time in filling their own legitimate spheres.

I remain, my dear Captain Selwyn, very faithfully yours,

THOS. TRIBE.

ANNUAL REPORT BY CHAS. TODD, ESQ., SUPERINTENDENT OF TELEGRAPHS, &c., SOUTH AUSTRALIA, 1863.

Observatory and Telegraph Department, Chief Office, Adelaide, April 6th, 1864.

Sir,—I have the honour to furnish you, for the information of His Excellency the Governor-in-Chief, with the following report on the operations of this department for the year ending 31st December, 1863.

NEW LINES.

The only extensions during the year were from Kadina to Port Wallaroo —rather more than seven miles; opened on March the 23rd; total cost, £416 13s. 7d.; and from Penola to Kincraig, thirty-one miles, costing £1,496 11s. 5d., on the 20th July. A station was also opened at Wellington on the 17th March.

The following statement exhib'ts the amount of business transacted at each of the foregoing stations, and the annual cost of management according to the estimates for the present financial year.

Station.	Cash Receipts.	Paid at other Stations.	Salaries of Officers, per annum.
Wallaroo	£131 16 0	£107 1 6	£175 0 0
Wellington	41 9 3	35 18 6	60 0 0
Kincraig	37 13 9	13 12 6	90 0 0

No station has been built at Wallaroo, but is much required, as I am at present obliged to rent a small wooden building consisting of two rooms of exceedingly limited dimensions, altogether insufficient to accommodate the officer in charge, who should reside on the premises. If a suitable building were erected I believe the postmaster-general would place the post-office under the charge of the station-master. The rapidly increasing trade of the port will soon render this one of our best outstations, and the transactions of the past year afford, in my opinion, but an imperfect criterion of what may be expected when the mineral resources of Yorke's Peninsula are more fully developed.

The station at Kincraig is placed under the charge of the Clerk of the Local Court, Mr. Horsfall, who, until a court house is erected, has to provide the necessary office accommodation. The single needle magnetic instrument is used to work with Penola, where the messages are repeated.

The station at Wellington is principally valuable to the police, to whom it has already rendered important aid. Mr. Carter has had charge of the office since November, an operator having previously been placed there to teach him, and it is only due to state that he has hitherto acquitted himself very creditably; but it will be obvious that his other duties as ferryman call him too much away from the office to allow of his efficiently performing the work of the telegraph.

On the removal of the military from the colony, it was thought desirable to place the comptroller of convicts at the Stockade, in direct telegraphic communication with the Adelaide office, and, in compliance with your instructions, I made arrangements, towards the end of the year, for carrying a special wire to the Stockade, communicating with the Central and Railway telegraph offices in Adelaide. The north line has been re-poled, and an additional wire suspended as far as the Dry Creek, from which point the communication is continued by the wires previously erected along the branch line to the Stockade. To render the system complete, an operator is required at the Stockade, and until one is appointed I fear the line will be practically useless, should its aid be necessary in any outbreak or disturbance among the prisoners.

The extent of lines open in South Australia, at the end of the year, was 747 miles, and 1,064½ miles of wires, connecting thirty-eight stations.

CONDITION OF LINES.

Most of our lines have now been up some years, and hitherto have cost but little for repairs. On the Port line, square Swan River mahogany poles were used, and although they have now been in the ground somewhat more than eight years, most of them are perfectly sound. On the Gawler line, round boxwood saplings from Kangaroo Island were planted; they have been up rather more than seven years, and are rapidly decaying, although I was led to expect great durability. They were, originally, too slight and short to bear more wires, and, in erecting the Stockade wire, I have recently re-poled the line as far as the Dry Creek.

The poles on the intercolonial line are mostly stringy-bark and gum saplings; they have been standing now between six and seven years, and, in some places, are becoming unsafe, and, owing to the extreme severity of last winter, considerable expense was incurred for repairs. I expect to have to re-pole the line, or the greater part of it, during the next three years, a moiety of the cost for which may have to be provided for in the estimates for the ensuing financial year. As we have no serviceable local timber between the ranges on this side of the Murray and Mount Burr, a distance of nearly 200 miles, it is a question whether it would not be better, and in the end cheaper, to use square poles (Swan River mahogany, or gum, &c.) instead of saplings, along the coast and for some miles beyond Guichen Bay. The New Zealand *totara podocarpus* has been very highly spoken of, and is, I understand, very extensively used by the natives in the construction of their "pas" and villages. Some of the logs which have been in the ground for fifty years have been found, it is stated, to be perfectly sound. On the northern lines native pine poles have been used throughout beyond Gawler town, and, at present, are mostly quite sound.

WORKING OF LINES.

With the exception of two serious interruptions on the intercolonial line in August and September last, the whole of the lines have worked satisfactorily. I have given in this report a detailed statement, showing every interruption, with its duration and locality, which occurred during the year, from which it appears that on the main line the communication has been wholly or partially suspended as follows.—

On the north lines, there were fifteen (15) interruptions, of which nine (9) were attributable to defects or inadvertence in the stations, causing stoppages varying from one and a-half (1½) to five and a-half (5½) hours, and amounting, in the aggregate, to twenty-five and a-half (25½) hours; one (1) of eight (8) hours to severe thunder storms; and four (4) to accidents on the line, one of which, caused by a bush fire, cut off the Kadina and Wallaroo offices for one and a-half (1½) days; the other three caused interruptions varying from two (2) to eight (8) hours, amounting in all to sixteen (16) hours.

On the South-eastern, No. 1 line, worked as far as Goolwa during the

greater part of the year, there were ten (10) interruptions, no less than seven (7) of which were caused at stations, amounting to three and a-half (3½) days and twelve (12) hours; and three (3) of thirteen (13) hours, in the aggregate, by accident on the line.

On the South-eastern, No. 2 line, which formed the main intercolonial line throughout the year, there were seven (7) interruptions, four (4) of which originated in offices, and three (3) on the lines. Of these, six (6) cut off our communication with Victoria; on one occasion for six (6) days, from July 30 to August 4, by the breaking of the wire in the swamps between Guichen Bay and Mount Gambier, and on another for four and a-half (4½) days, through a defect in the wires leading into the Guichen Bay office, which the station-master unfortunately failed to discover until after the whole of the line between Guichen Bay and McGrath's Flat had been carefully inspected. The other three stoppages on the intercolonial line were trifling, amounting in the aggregate to 15 or 16 working hours; although, owing to the severity of the winter season, the line occasionally worked badly in the months of July, August, and part of September.

If we take into consideration the nature of the country traversed, and the exposed positions of the lines to all sorts of injury, and the difficulty in some cases of promptly effecting the repairs, especially where the line crosses, as in the South-eastern district, extensive swamps, in many places, last winter, three or four feet under water for many miles, it will, I think, be admitted that the interruptions are much fewer, and of shorter duration than could be expected. Persons give us credit for many delays which never occurred; for instance, it is very commonly reported, especially in Melbourne, that the line is rarely in working order when the English mail arrives, while the contrary is really the case; the line is seldom interrupted at mail times, and, not unfrequently, the English news has been so promptly transmitted to Melbourne, as to place the public there in possession of the intelligence before it has become generally known in Adelaide.

To prove this I have prepared the following statement, showing the rate at which mail messages have been transmitted during the last two years, 1862 and 1863.

Table showing the rate at which Mail Reports were transmitted from Adelaide to Mount Gambier during the years 1862 *and* 1863.

Date of arrival at Glenelg.	Average rate of transmission; number of words per hour, including stoppages.	Remarks.
1862.		
January 11, 1.30 p.m.	1,600 words	Reports reached Adelaide at 2.35. The first report of 1,788 words finished at 3.45.
February........	—	No mail.
March 11	1,400 words	Commenced at once. First report of 2,148 words finished at 1.20 a.m. of March 12.
April 15, 3.30 a.m. ...	1,400 "	All the reports finished at 7 a.m.
May 9, 7.30 a.m. ...	1,100 "	All the reports finished at 12.50 p.m.
June 9, 11 p.m.	1,200 "	Maximum rate of transmission, 1,500 an hour. All finished at 2 a.m. of 10th.
July .... August........ September	—	No mails.
October 7, 12 noon ..	1,350 words	All finished at 4.35 p.m.
November 10, 5 a.m. .	1,100 "	First report finished at 7 a.m.; all at 9.15 a.m.
December 12, 1 a.m. .	1,450 "	All finished at 4.18 a.m.
1863.		
January 12, 5.35 a.m..	1,100 words	First report finished at 6.50 a.m.; all at 10.30.
February 12, 1.41 p.m.	1,100 "	Maximum rate, 1,500. All finished at 4.45 a.m. on 13th.
March 17, 5.43 p.m...	550 "	Line working badly; heavy rain throughout. Last report sent at the rate of 840 words an hour; all finished at 3.25 a.m. on 18th.
April 12, 9.5 p.m. (Sunday)	1,050 "	First report of 2,365 words received at 10.30 a.m.; finished at 12.45.
May 11.........	—	Steamer brought no mail.
June 14, 1 p.m. (Sunday)	1,350 words	The first report of 2,725 words was sent in two hours, and over 9,000 words under eight hours.
July 11, 8 a.m.	1,400 "	The first report of 2,425 words commenced at 9.20, & finished at 11.5.
August 9, 8.18 p.m..	1,100 "	All finished at 3 a.m. on 10th.
September 8, 10 p.m..	—	Line interrupted. [*Vide* table of interruptions.]
October 8, 6 p.m. ...	1,250 words	All finished at 10.50 p.m.
November 12, 4.35 p.m.	1,275 "	Finished at 8.25 p.m.
Dec. 13, 11.15 a.m. ..	361 to 600 words	Reached Adelaide at 1; commenced at 2 p.m.; line interrupted for about five hours after reports were commenced. The last half of the reports transmitted at the rate of 600 words an hour. Furious gales, with drenching rain and lightning along the whole line.

From the foregoing, it appears, therefore, that so far from the telegraph invariably failing on the arrival of the mail, it has done so only once during the past two years. On several occasions last year, which was remarkable for its atmospheric disturbances, we had exceedingly unfavourable weather just as the mail came in. In March, for instance, we had heavy rain along the whole of the South Australian line, and similar weather in Victoria; but, although the messages were transmitted with considerable difficulty, the great bulk of them were sent, after a little delay, direct to Mount Gambier, a distance of 300 miles.

It will be remembered by every one that, on the arrival of the mail in December last, a furious gale, with heavy driving showers, preceded by severe thunderstorms, swept across the whole of our coast lines. The mail arrived on Sunday at one (1) p.m., and was immediately notified to Melbourne, and, despite the increasing severity of the weather, the despatches, after a few hours' delay, were transmitted over a circuit of 300 miles at nearly the ordinary rate.

When the extension of the telegraph was first proposed, our oldest colonists predicted that it would be constantly liable to interruption. Now, however, although when it is put to them, persons will acknowledge that it is, after all, more surprising that the interruptions are so few, than that they are so frequent; they are, nevertheless, very apt to exaggerate the failures and impute negligence whenever they themselves experience any personal inconvenience. And one stoppage on the arrival of the mail causes so much disappointment, that one can readily understand how it should leave a deeper impression on the memory than a dozen successful operations.

As an instance of the disposition shown by some to attribute every delay to defects or obstructions on the line, I may cite the following .—On the arrival of the English mail in February, the only despatches landed at Glenelg were those addressed to the Melbourne *Argus*, and *Sydney Morning Herald*, with a few private telegrams under the same cover. These reached the Adelaide office at 6.45 p.m., and were immediately transmitted direct to Melbourne (without repeating), over a circuit of 700 miles, at the rate of about 1,200 words an hour, including all stoppages. On their completion, the line was wholly unoccupied for nearly three (3) hours, the rest of the despatches not having arrived from the port. This was explained by the manager in the Melbourne office, and it must have been known, therefore, that the line was waiting; the *Melbourne Herald*, nevertheless, attributed the delay to the South Australian Telegraph.

It is right to mention that the *Argus* acknowledged the early transmission of the first report, and neither that paper nor the *Sydney Morning Herald* has complained of telegraphic delays for some time past.

I regret to have to report frequent and extensive damage to our lines, especially where they pass through country townships, by mischievous persons throwing stones at the insulators. Much of our difficulty in bad weather arises from this cause. With a view of preventing it, I propose affixing a notice on the poles offering a reward for the apprehension of any offender. We had nearly 100 insulators broken, between Adelaide and Mount Barker, in a few days at Christmas.

Mistakes in Telegrams.

The errors of the telegraph have become a proverb in all parts of the world where it exists, and it would be worse than useless for me to attempt to combat the almost universal opinion. Nor will I set up a claim on behalf of my own department for more than ordinary accuracy. Another time I hope to be able to place before you some reliable statistics as to the number of errors, for it is my intention in future to have a record kept of every mistake of which complaint is made. I will here content myself with referring to the errors which came to my own knowledge during the past year, and offer a few suggestions which, if adopted, would, I think, tend very considerably to diminish the number and importance of telegraphic blunders.

It may be safely assumed that no important errors or delays, involving pecuniary loss or serious inconvenience, occur which do not come before me. Now, out of the 86,411 messages which passed through our offices during the year, I have a record in my letter-book of sixteen (16) being referred to me containing mistakes; and, as far as my memory serves me, scarcely as many more came under my notice, which were replied to verbally.

I shall be quite safe in saying that not more than thirty-six (36) messages were referred personally to me, as erroneous. Two of these were mistakes on the part of the sender, in addressing the message to the wrong firm; one was the omission of a full stop, and as it is instructive, and will at this time be no breach of faith, I will give it. The original message read thus:—"Butter sold returns as last. Send more. Flour thirteen ten (£13 10s.)" It was sent thus:—Butter sold returns as last. Send more flour thirteen ten (£13 10s.)" And I believe more flour, instead of more butter, was sent to Melbourne.

The errors referred to me would be those of the greatest importance. On reference to the cashier in the Adelaide Office, through whose hands at least 60,000 messages passed in the last twelve months, I find that on the average one message in three days is referred back to the office for explanation. It is not, of course, pretended that only one hundred (100) errors were made; but what I have stated serves to show, that out of some 60,000 messages not many more than 100 contained errors of sufficient gravity to require their being sent back for explanation.

This, I think, is very creditable to the department; for it must be remembered that every message has to run the chance first of being sent

incorrectly by the transmitting operator, who at a busy instrument has often no opportunity of previously reading the messages he transmits, which, by-the-bye, are frequently badly written, and secondly, of being wrongly rendered by the receiving clerk, who writes it at the dictation of the instrument, the utterances of which are affected by the state of the weather, &c.

Many errors occur in the rendering of words having a similarity of sound, such as "to" for "two;" "for" for "four," &c.; and from the code signals of two different words closely resembling each other unless sent carefully; for example, in one instance the word tons (— ——— —· ···) was substituted for kegs (—·— · ——· ···), the operator transmitting the word thus (—·—·——·—·····). "Meet" (—— · · —) is liable to be read "get" (——· · —).

The most singular error I have met with was in a message in which the sender telegraphed for the "coil of belting;" it was written very indistinctly, and the operator transmitted it, "Send the evil of betting." One can imagine the perplexity of the receiver.

The most serious errors occur in quotations, and might be easily avoided if persons would repeat them in a different form, so as to enable the receiver to verify the correctness of the telegram; thus, "Wheat five and six—sixty-six." "Flour eighteen ten—three seventy;" "one thousand—twice five hundred," and so on. There is some little art in writing a telegram properly; persons should always avoid writing a message so that its sense may be reversed or wholly altered by the omission of a single word. "Not," for instance, is a very dangerous word where the sense of a message wholly depends upon it.

Questions as to the authenticity of bank credit telegrams have at times been raised; the difficulty in the majority of cases might perhaps be met somewhat in the following way: suppose the manager of a bank in Melbourne to have frequent occasion to telegraph to the manager in Adelaide, who it is desirable should be able to determine the genuineness of each telegram, let the former select a number of words—"Jericho," "Jordan," "Jerusalem," &c., and send a list to the Adelaide manager; and afterwards let each message commence with one of the words fixed on, taking them in consecutive order; the first beginning "Jericho," and so on. If this were adopted, it would be quite impossible for any fraud to be committed, for no one could discover the "key." Letters would not be so good as words, as the operator would be more liable to mistake them.

There is no doubt that important messages should be repeated; but the public complain of the extra expense; and I think the charge for repeating might with advantage be considerably reduced for the higher rate messages.

It is, of course, our duty to guard against mistakes in every possible way, and to adopt every possible precaution which circumstances permit; and this is done. It has been suggested that a system of fines would act beneficially, by inducing greater care on the part of operators, and perhaps it might. Unfortunately, however, the system would press unfairly on our best operators, who, as such, are placed at the instruments which do the most business; and, as it would be unreasonable to expect that the number of errors would—the operators being equal—vary with the number of messages, that operator who had most to do would make the greater number of mistakes. Indeed, the one who had less to do, and therefore more time to be careful, should, from that very circumstance, make proportionally much fewer errors. Thus it will be seen that, while one operator at a busy station will with every care be certain to make mistakes, through the pressure of business, another operator, who may perhaps be really less careful and painstaking, yet having less to do and more time to do it in, will be, from that circumstance, more exempt from errors. It is better in practice to treat each case on its own merits; and if an operator is found to be habitually careless, the superintendent should have the power of summarily dismissing him.

(To be continued.)

TELEGRAPHIC NEWS.

Another Transatlantic Telegraph.—*On dit* that a Company has been formed in Spain, with a large capital, for the purpose of carrying a novel telegraph cable across the Atlantic by a new route.

Electric Induction.—At the meeting of the British Association, now being held at Bath, J. B. Thompson, Esq. will read a paper on "The Mechanical Theory and Application of the Laws of Magnetic Induction." We hope to be able to lay this valuable contribution to scientific literature before our readers next week.

Telegraph Improvements.—The sporting papers of the week announce that at Doncaster race-course, the wooden sheds of the Magnetic and Electric Telegraph Companies have been replaced by permanent offices, whilst the unsightly telegraph posts have disappeared, and the wires are carried underground.

The Velocity of Electricity and the duration of the spark have been made the subject of experiment with new apparatus by M. Felici, of Pisa, and described in the *Cimento.* He has determined the velocity to be 260,000 kilometres per second. The following are the determinations of other philosophers:—Wheatstone, 480,000 kilometres; Fizeau and Gounelle, 180,000; the astronomers of London and Edinburgh, 12,200; those of Brussels, 4,300. The kilometre is 0·6213 mile.

The Indo-European Telegraph.—We are glad to be able to announce that the convention between the Ottoman Government and the Government of India for the Indo-European telegraph, viâ Bagdad and the Persian Gulf, was signed on Saturday last, the 3rd of September, by the respective plenipotentiaries of the British and Turkish Governments.—*Levant Herald.*

Atlantic Telegraph Company.—The following circular has been sent to all the shareholders and others interested in the above undertaking:—"Atlantic Telegraph Company.—Notice of Removal from 22, Old Broad Street.—The offices of the Atlantic Telegraph Company are now removed to No. 12, St. Helen's Place, Bishopsgate Within, E.C., to which place all communications are in future to be addressed.—George Saward, Secretary and General Superintendent.—12, St. Helen's Place, Bishopsgate Street, September, 1864."

Interruption of Telegraphic Communication between Benghazi and Alexandria.—We regret to state that an interruption of communication on the cable between Benghazi and Alexandria occurred on the 6th September. The position of the break is said to be from 180 to 200 miles from Benghasi. The screw steamer Fanny Lambert, which has been lying some time in the Malta Harbour and is fitted with the necessary apparatus for lifting up the cable, left on the 8th, having on board Messrs. Temple, Saunders, Gibbs, Windle, Fryer, Joss, Smith, Bence, Horne, Stephens, Bacon, Jarman, Hough, Hoskins, Marshal, and M'Combie, of the telegraph staff, for the purpose of repairing the faulty part, and will be assisted by her Majesty's screw steam corvette Racer, to follow as soon as a telegraph official expected from England arrives.

The Otrante and Avlona Cable has been satisfactorily completed. The previous attempt to submerge this cable in the month of February last proved unsuccessful on account of severe gales having been encountered which drove the vessel out of her course, whereby the end of the cable was lost. The repairing expedition, under the personal superintendence of the contractor, Mr. W. T. Henley, has succeeded in picking up the end from a depth of 569 fathoms (the greatest depth from which any submarine cable has been recovered). The completion of this line will bring Constantinople into more direct communication with London than before.

Electric Clocks.—Last month a large electric clock was put up in front of the Main Guard, on St. George's-square, Malta. This time-piece has a dial two feet in diameter, and is placed in a lantern. It is visible from the Palace, works with great regularity, and has a very striking effect when lit up by gas at night. Stoppages are not likely to occur when everything is properly regulated and systematized, and a proper amount of motive power, as well as duplicates of it, for exchanging exhausted batteries, are at the disposal of Mr. Rosenbusch, to whom great praise is due for his zeal and disinterestedness in promoting the adoption of this useful and novel timekeeper.

New Zealand.—The military electric telegraph is not to stop at Ngaruawahia, but is to be extended to all the outlying posts and down to Raglan, on the west, and Tauranga, on the east coast. The material for this is now on its way here, and a staff of engineers left Auckland on Friday, 13th May, to make the necessary preparations. When the material comes to hand the work will not be long in execution, and we may expect, before many months, to be in telegraphic communication with the principal military posts throughout the island. We would suggest to the Provincial Government that a single wire to Onehunga could be put up and worked at a comparatively small cost, and that with vessels arriving there so frequently as they do now, it would be a great public convenience.—*Southern Cross.*

New South Wales.—A deputation of gentlemen, representing the coal mining property at Lake Macquarie, waited on the Minister for Works with a view to certain improvements being effected in the navigation of the entrance of the lake. The minister promised to give his immediate attention to the matter, the improvements sought being estimated at above £3,500. Several new private buildings are begun, and many alterations of premises in various parts of the city are in progress. The Episcopalian church at Binda is finished, a neat and substantial edifice of rubble stone. It will be seen in another part of our summary how severely we have been again afflicted with floods; and such a calamity has not only injured many Government works, but considerably damaged private property. For repairs towards bridges, railways, harbours, electric telegraph posts, jetties, and other public property, the Minister for Works will have to submit to the next session of Parliament a considerable item on the supplementary estimates.—*Empire.*

The Telegraph to America.—Adverting to the Atlantic telegraph, the *Morning Herald* observes:—"One of the most serious difficulties with which those engaged in laying telegraph cables have to contend arises from the risk of snapping or straining the cable when paying it out over the stern of the ship. In calm weather the "paying out" is comparatively easy; but when the sea is rough, and the vessel rises and falls with the motion of gigantic waves, the probabilities of severing the cable are increased to such a degree as to render the task well nigh impossible. Experience, however, has made telegraphic engineers fertile in contrivances, and an apparatus has been constructed to regulate the rate of discharge of the cable from the Great Eastern, which it is believed will compensate for the unequal strain which would otherwise be created by the violent motion of the vessel in a heavy sea. It is not known to what cause the failure of the first cable is to be attributed. The insulation of the wires was destroyed; but whether from the effects of a strain in laying the cable, or from an injury sustained

by the latter by coming in contact with some sharp submarine reef, or, as some conjectured, from the effects of the superincumbent weight of the ocean, was never discovered. In the construction of the present cable, which is considerably larger and stronger than the previous one, great pains have been taken to guard against the known as well as the suspected dangers of the hidden depths of the ocean, and the projectors are confident that, if once securely laid across the Atlantic, telegraphic communication will henceforth continue uninterrupted between the continents of Europe and America. The civilized world has now become so habituated to telegraphic intelligence, that any break in the chain of communication between different parts of the globe is regarded as a misfortune which is positively intolerable. The time was—and not very long since either—when we considered we had achieved much in obtaining intelligence of what passed in New York or Washington in less than a fortnight after its occurrence. But the triumphs of electricity have, so far as regards the transmission of tidings, thrown those of steam into the shade. When we find on our breakfast-table each morning short abstracts of the chief events which have taken place during the preceding twenty-four hours in every capital in Europe, we cannot refrain from a feeling of disappointment on reflecting that we will have to wait at least ten days to learn the simultaneous occurrences at the other side of the Atlantic. And there certainly are occasions on which this thirst for early news is not the mere offspring of pampered curiosity. At the time when the outrage on the passengers in the Trent was committed, telegraphic communication between this country and America would not merely have served to allay much anxiety, but would have been the means of saving this country a large expenditure of money. We were compelled to transmit instructions in the ordinary way to our ambassador, and, meantime, to guard against a possible refusal by the American Government to comply with our demands, we were forced to despatch troops to Canada. Had telegraphic communication been possible at that time our wishes would have been made known, and the subsequent concession of the American Government been granted, within less time than was necessary to prepare for the transportation of the troops which were sent to defend our American colonies in the event of a war."

CAUTION AGAINST INTERFERENCE WITH THE TELEGRAPH.—A copy of the following circular has been forwarded to every station agent and telegraphist employed on the London and South-Western Railway :—"On the 9th August, George Thomas Scott, whose father is a porter employed at Gillingham Station, was summoned before the magistrates sitting in petty sessions at Shaftesbury, on a charge of interrupting the transmission of various messages passing through the instrument. Three cases were gone into, but the boy being only thirteen years of age, the magistrates were disposed to deal leniently with him, and discharged him with a caution, considering the blame to rest primarily with those who, being in charge, allowed the telegraph to be exposed to such irregularities. Undoubtedly the persons chiefly to blame were the station agent and telegraphist at Gillingham; and all concerned should be aware that in any future case of the kind the law will be found to apply as well to those who, by their negligence, conduce to interruptions as to the actual perpetrator.—W. H. PREECE, ARCHD. SCOTT.—Telegraph Department, Southampton Station, 25th of August, 1864."

MISCELLANEA.

FIRST USE OF PENS.—A writer in the *British Quarterly Review* tells us that Queen Jezabel is the first letter writer on record, and that she used her pen for purposes of deception.

ACUTE OBSERVATION OF THE EFFECTS OF CRINOLINE ON THE MAGNETIC NEEDLE.—A Kingston (Canada) paper speaks of the smoke from the fires which prevail around the country as impeding navigation on the river St. Lawrence; and the other day, in the case of a pleasure party on a steamboat, while the smoke was so dense as to require the use of the compass, there were so many fair passengers with steel hoops that the compass became entirely unreliable, and the boat finally brought up at Portsmouth instead of Kingston!

THE NEW ZEALAND EXHIBITION.—Papers are now being distributed detailing the various regulations under which articles will be received for and exhibited at this Exhibition, to be opened in the city of Dunedin on the first Tuesday in January, 1865. The articles exhibited will be divided into classes or sections, consisting of raw materials, machinery, manufactures, and fine arts. The Commissioners will receive articles on or after the 1st of October next, and will continue to receive goods until the 12th December in the present year. Application for space and other information is directed to be made to Mr. John Morrison, New Zealand Government Agency, 3, Adelaide-place, King William-street, London, E.C.

ALUMINIUM.—A new method for obtaining this metal at a very small cost has just been discovered, says *Galignani*, by M. Corbelli. He takes a certain quantity of fine clay, say 100 grammes, and dissolves it in six times its weight of concentrated sulphuric, nitric, or hydrochloric acid. The solution is then allowed to stand, and is afterwards decanted. The residue is first dried and then heated to 450° or 500° centigrade; after which it is mixed with 200 grammes of prussiate of potash, which may be increased or diminished according to the quantity of silica contained in the clay. To this mixture 150 grammes of common salt are added. The whole is then put into a crucible and heated until the mixture becomes white; when cool, a button of pure alminium is found at the bottom of the crucible.

ARRIVAL OF THE MAIL IN MELBOURNE.—A writer in *Chambers' Journal* makes the following observations concerning the reception of news from Europe and its transmission from Adelaide to the inland towns :—"About the 5th of every month the telegraph authorities in Melbourne make their first preparations for the reception of the summary of English news. One of the clerks in the office, called an operator, has to sleep all night in the office, with a bell over his head, which is rung by electricity. This arrangement is a very necessary one, as the arrival of the mail is sometimes telegraphed in the middle of the night. The mail telegraphic correspondence, in nine cases out of ten is first carried on between Adelaide, the capital of South Australia, and Melbourne, the capital of Victoria. It is at Adelaide that the mail steamer arrives first, and that town consequently is the first to get the European news and the first to transmit it."

THE INFLUENCE OF LIGHT ON THE RETINA.—All the senses are more or less subject to deception; but the eye is pre-eminently so; especially when the sensibility of the retina, and also the imagination, are unduly excited by disease. If we fix the eyes upon a highly illuminated object for a few seconds, and then look toward a clear wall, or the sky—the mind being unattracted by other things—we will see an exact figure of that object; this illusion will gradually grow fainter until it vanishes entirely. We are thus naturally led to the conclusion that the impression of light on the retina of the eye is not merely instantaneous, but that it actually continues during a certain time after the luminous or illuminated object has been withdrawn.

CURIOUS EFFECT OF LIGHTNING.—The *Journal de Loiret* relates the following curious fact on the authority of M. Lebigue, Mayor of Nivelle :—"As three men were gathering pears on Sunday last in that commune, the lightning struck the tree, and passing down it in a spiral line, stripped off a piece of bark from top to bottom, about half an inch thick and four inches wide. One of the men, who happened to be eating his breakfast near the foot of the tree was killed on the spot, as was also a dog standing near him. The other two men, who were in the tree when the lightning flashed, were knocked down by the shock, and remained for some time insensible. On reviving they found their legs in a measure paralysed, but recovered the use of them before evening. On examining one of the men an impression of the branches and foliage of the pear tree was found distinctly printed on his breast—a phenomenon of which many instances are recorded."

THE PROGRESS OF CIVILIZATION.—The Maories at Waikato Heads, we are told, are becoming patrons of the Savings' Bank, and there has been a considerable sum lodged by them. It is an important change in their habits, that of the appreciation of the system of increase in money by interest, instead of the desire to hord specie in their whares. It destroys the spirit of communism which has hitherto prevailed amongst them and which induced them to share any money each might have gained. The desire of individualising property once established amongst them, they will settle down and attend to their own interests without being swayed by every barbarous caprice of a tribe. It will also be an additional tie to civilisation, and the thought of money invested with the pakehas will counteract any desire to quarrel with them. Another improvement is the establishment of co-operative stores, by which a gang of Maories engaged on any undertaking, such as a surveying party, may obtain their goods by wholesale and supply one another with every man's share, keeping an account of how much each is entitled to.—*New Zealander.*

MAGNESIUM.—A correspondent of *Notes and Queries* has forwarded to that interesting publication a paragraph which originally appeared in this journal, and thereto has appended the following remarks :—"I have purchased a few feet of the wire, and find the statement correct—a more brilliant and beautiful light it would be difficult to imagine; and I suppose it will not be long ere many uses are found for it in the arts of peace and war. I have also seen some *cartes de visite* of Sir Henry Holland, Professors Faraday and Roscoe, and others, taken by its light; and, unless assured of the fact, could not have distinguished them from first-rate sun portraits. Probably photographers will now commence to work by night as well as by day, and relieve their stout and elderly customers from tiresome ascents to studios on the roofs of houses. Magnesium, I learn, is at present extracted from magnesia at works in Salford, Manchester, under the superintendence of Mr. Sonstadt, who, notwithstanding his name, is an Englishman, but of Swedish descent.—HARDIE CLARKE."

EXPLORATIONS IN NORTH WEST AUSTRALIA.—THE DISTRICT OF THE GLENELG.—In the division of the indigenous vegetable productions little can be safely predicated until opportunity has been afforded for an investigation into the medicinal properties of the plants already discovered, which doubtless form a very inconsiderable number of this class within even the limited area explored. The abrus and the anatherum, the pea, and the lemon grass, as of most frequent occurrence, may be considered first: from the roots of the former we expect a perfect substitute for liquorice in every respect; from an infusion of the leaves of the latter we know, from Indian experience, we can obtain a tea acknowledged to be stomachic, tonic, and useful in dyspepsia. From the convolvulaceæ, one species of which is included in the genus ipomœa, we may extract deoretin, affirmed to be identical with jalapin; from a second species of the genus convolvulus, scammony or a canthartic resin of equal value may be prepared from the expressed juice of its roots and stalks. From the root stocks of the typha extracts astringent and diuretic are obtainable. An elastic gum, something like India-rubber, and gum tragacynth have been found. Sandaric resin can be procured from the pine, and gum resin of various descriptions from several of the eucalypti.

Electrical Phenomenon.—On Saturday, the 10th instant, between four and five o'clock, a thunderstorm of unusual violence passed over Cheadle and the district, creating considerable alarm. In one instance the electric fluid struck the residence of Joseph Alcock, Esq., of The Croft, near the town, passing through the roof into a room used as a lumber-room, where it set on fire some bags containing feathers and also some loose strips of wood. The housemaid, Susan Bailey, who was in her bedroom on the opposite side of the passage, received a shock which nearly threw her down. On recovering she went into the lumber-room, and, with great presence of mind, took some water and put the fire out. From the latter room the electricity passed through a wooden partition along a bell-wire leading to the drawing-room below, where it shivered to pieces the glass in a picture-frame, while several panes in the window were blown out. Mr. and Mrs. Alcock, who were sitting in the dining-room, received a shock, the latter severely, the former but slightly. In a bedroom over the dining-room the paper was torn up in one corner, but no other marks were to be seen to indicate the passage of the subtle visitor. Had this phenomenon occurred in the night the consequences might have been fatal to the occupants of the building.

The Conductors of Sound.—The air is one medium by which sound is conveyed. But solid bodies convey sounds much better than the air; this fact you may readily prove by placing your ear flat and close upon the end of a long table or a marble chimney-piece, and asking another person to scratch or rap gently with a pin or other body at the other extremity. It is very curious to note how you can thus appreciate the sound produced by the most delicate impulse. Now lift your ear from the table and raise it only two inches, and you can with difficulty distinguish the slightest sound. Solid bodies then are better conductors of sounds than the air; and moreover they convey them with a far greater velocity, as has been proved by the following curious experiment:—"A metallic wire 600 feet long was stretched horizontally, and at one end a plate of sonorous metal was attached; when the plate was slightly struck, a person at the opposite end, holding the wire in his teeth, heard at every blow two distinct sounds, the first transmitted almost simultaneously by the metal, the other arriving later through the air." . . . . But sound is also communicated by liquids: water is an admirable conductor of sound, and though not so good a one as hard and elastic bodies, it is far superior to air. If you have any doubt of this fact let me recommend you to dive down into some pond or river, and take two stones or pebbles from the bottom and knock them together several times in succession. How loud the sound seems! Now come to the surface, and after taking breath take a couple of quoits down with you, and strike them together close to your ear. Why, the noise is almost deafening; and you are satisfied that water is an excellent conductor of sound. Now let me ask you to try the effect of sound proceeding from the rarer medium of air into the denser one of water. Ask your friend on the river bank to strike these same quoits together, while you are under the water. "Did you hear anything?" "Not a sound of any kind," you will reply. Ask him to halloo and shout with all his might. "Could you distinguish any noise?" "I thought I could just recognise a feeble and confused sound as if it proceeded from a great distance." "Perhaps so—but your head was not more than three or four feet beneath the surface; if you will sink down a few feet deeper, you will not hear the slightest indication of a sound."

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2182. W. J. Curtis, improvements in railway carriages and in the means to be employed by passengers in signalling to the guard of railway trains.

2216. M. Fitzgerald and J. S. Phené, protection of the lives and persons of travellers on railways by improved signal communication between any passenger and the guard and other passengers.

2217. H. W. Cook, improvements in electric telegraphs.—A communication.

2218. A. A. Davis, improvements in apparatus for communicating or signalling between the guard and driver, and between the passengers and guard or driver of railway trains.

2228. A. G. Grant, a clock-work magnesium lamp, with reflectors, magnifiers, and condensers, for the burning of magnesium wire to produce powerful light.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2038. W. Milligan, for the invention of an apparatus for communicating motion from one railway carriage to another in a train, applicable for signalling between passengers, guard, and driver, fastening and unfastening the carriage doors, working the breaks, and other purposes.

2049. W. Clark, improvements in apparatus for transmitting motion and power from one part of a railway train to another, for the purpose of effecting communication between the passengers and guard, or otherwise, and for operating the breaks.—A communication.

2052. C. Cotton, improvements in railway carriages, to facilitate the communication of passengers from carriage to carriage of a railway train.

2053. W. Thomas, improvements in effecting communication between passengers and guard or other person in charge of railway trains.

2063. J. Thomsen, improvements in batteries for generating electricity, and in apparatus for converting the quantity thereof into intensity.

2078. T. H. Cleveland, improvements in means or apparatus for signalling between passengers and guards or other persons in charge of railway trains.

2080. R. A. Brooman, improvements in machinery for winding, unwinding, and paying out telegraph cables, applicable also to winding and unwinding cords, ropes, and wires.—A communication.

2123. R. A. Brooman, improvements in signalling apparatus, specially applicable to signalling on board ship.—A communication.

2134. G. Witson, improved means of communicating between passengers, and between passengers and guards, on railways.

2141. Sir J. Mackneill, improvements in railway signals.

PATENT SEALED.

661. E. F. Ruffin, improvements in marine and land signals.

PATENT WHICH HAS BECOME VOID.

2174. C. Pemberton, improvements in railway, ship, and other signals.

NOTICES TO PROCEED.

1126. W. T. Henley, improvements in telegraph wires and cables, and in apparatus used in their manufacture, parts of which improvements are applicable to other useful purposes.

1234. A. Reid, improvements in apparatus used for testing the insulation of electric telegraph wires or conductors.

2064. G. Davies, improvements in submarine shells or torpedoes, and in apparatus for operating the same.—A communication.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.	

India Rubber.

Para, first quality	1/8½ to 1/9	,,
second ,,	1/5 to 1/6	,,
third Negro-head	1/2½	,,
Java and Penang	1/3 to 1/5	,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	102 to 106	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1 to ½ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 3½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to par	—

TO CORRESPONDENTS.

E. Walsh wishes to know if it is likely that electricity or the galvanic battery will supply a motive power equal and economical as steam at present gives?—Several efforts have been made by Professor Joule, Mr. Allan, Mr. Baynes Thompson, and others, to construct electro-magnetic engines. The great expense of battery power has hitherto delayed the adoption of the electro-magnetic engine for practical purposes; nevertheless, we do not despair of ultimate success in rendering the machine one of real utility.

We have arranged for securing a lengthened report of the proceedings of the British Association now being held at Bath.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

Quarterly, 4*s.* 4*d.* | Half-yearly, 8*s.* 8*d.* | Yearly, 17*s.* 4*d.*

THE TELEGRAPHIC JOURNAL.

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THE TELEGRAPH IN SOUTH AUSTRALIA.

THE report of the superintendent of telegraphs in South Australia, for the year 1863, has just reached us, and, with an appendix, contains some very valuable information. At the close of the year the means of telegraphic communication in this colony extended over an area of 747 miles. The telegraph consists of 1,064½ miles of wire, connecting thirty-eight stations. (Thirty-eight miles of additional wire have been opened for traffic since the date of the last report, and are included in the above estimate.) The cost of maintenance has hitherto been very trifling, but, owing to the heavy gales and long-continued rains of last season, the item for repairs is unusually heavy. It will be interesting to our readers to learn that the Morse instrument (read by sound) is used on the main lines, and that Henley's magnetic single-needle telegraph is employed for the railway service and for branch lines. These are found to work efficiently.

In reply to several complaints made by uninformed persons relative to delay in the transmission of intelligence, the superintendent of telegraphs furnishes statistics of the time in which mail messages are forwarded; and, certainly, the rate of sending and receiving is equal to some of the best performances on European lines. In the ordinary course of business occasional errors of omission or commission are comparatively unavoidable. It is very necessary that some plan should be adopted, whereby the public may be guaranteed the greatest possible accuracy, as mistakes are likely to lead to serious mischief. The Electric and International, the Magnetic, the Submarine, and United Kingdom Telegraph Companies, in seeking this end, have been led to the practice of levying fines for errors, which has, for several years, been a source of annoyance to the most skilled operators on our English lines. Mr. Todd appears to be aware of this fact, and observes, "It has been suggested that a system of fines would act beneficially, by inducing greater care on the part of the manipulators, and so it might. Unfortunately, however, the system would press unfairly on our best operators, who, as such, are placed at the instruments which do the most business; and, as it would be unreasonable to expect that the number of errors would—the operators being equal—vary with the number of messages, that operator who had most to do would make the greater number of mistakes. Indeed, the one who had less to do, and therefore more time to be careful, should, from that very circumstance, make proportionally much fewer errors. Thus it will be seen that, while one operator at a busy station will, with care, be certain to make mistakes, through the pressure of business, another operator, who may perhaps be really less careful and painstaking, yet having less to do and more time to do it in, will be, from that circumstance, more exempt from errors. It is better in practice to treat each case on its own merits; and if an operator is found to be habitually careless, the superintendent should have the power of summarily dismissing him." Were the vexatious system of fining for errors entirely abolished, and were premiums offered for accuracy and expedition in the transmission of messages, every practicable precaution would be observed by operators in their manipulation of the various instruments.

But to return to the colonies. Several important extensions of the telegraph are recommended in the aforesaid report; but it would seem that, until the governments of the various colonies agree upon the proportion in which the anticipated receipts are to be divided, very little progress will be made. In New South Wales, arrangements are pending for a line from Deniliquin to the South Australian frontier. On the Victorian line it is proposed to erect a second wire, to connect Hexham to Hamilton, and thus establish an inland communication between Melbourne and Portland. Both these important works are in abeyance, for the reason before stated.

The financial condition of this colonial telegraph is not so satisfactory as we could wish. The number of messages has increased, and the receipts for the same have been proportionally augmented since 1862, yet the expenditure exceeds the income. It appears that the number of telegrams increased from 76,725 in 1862, to 86,411 in 1863; and the revenue from £7,677 5*s*. 8*d*. in the former year, to £8,429 19*s*. 1*d*. in the latter. The total value of messages in each year was respectively £11,801 3*s*. 7*d*. and £13,120 16*s*. 7*d*., being an increase of £1,319 13*s*. The expenditure, exclusive of the outlay for new lines, was £9,968 18*s*. 10*d*. Of this amount, £8,798 0*s*. 1*d*. was the proportion charged to the working expenses or maintenance account; or, adding the rent of the chief office (£310), £9,108 0*s*. 1*d*., a sum exceeding the net revenue by £678 1*s*. 7*d*., a fact to be accounted for by the circumstance that eleven out of thirty-eight stations are not yet self-supporting.

In estimating the value of the telegraph in a new country it is necessary to consider its collateral as well as its immediate advantages. We regret that, after four years' operations, the South Australian lines should be found to be unremunerative; but it must be conceded that the aid they afford to commercial enterprise, to the officers of justice, and to the general development of the colony, fully counterbalances, in importance, the difference shown on the debtor against the creditor side of the ledger. The importance of the telegraph has been recognised in South Australia, as elsewhere, and under the able direction of Mr. Todd it promises to become a permanent and profitable institution.

THE MECHANICAL THEORY AND APPLICATION OF THE LAWS OF MAGNETIC INDUCTION OF ELECTRICITY.*

BY J. BAYNES THOMPSON, ESQ.

IN speaking of the mechanical application of the laws of magnetic induction of Electricity, it will be necessary first to state partially, at least, the theory of that induction, and the laws included in it.

ELECTRICITY AND MAGNETISM CONSIDERED AS FORCE.

We are in the habit of speaking of Electricity and Magnetism as fluids—imponderable fluids! That is, matter without weight. As if it were possible that there could be matter either solid or fluid without weight. All matter must have gravity to whatever system it may belong; for gravity or weight means only this, that in every system of matter there is a common bond of union or centre of attraction. If electricity were a fluid it could not be induced: one fluid does not induce another. Motion may be induced in one fluid by another fluid, which is

* Read at the meeting of the British Association held at Bath, 17th September, 1864.

itself in motion, at the expense of its own motion; but this is not a question of the fluid but of the motion. Throughout all Nature there is no induction but that of motion, which is change of state or change of place. If it be internal motion, then it is change of state; if local motion, then change of place. This is self-evident almost of the force of an axiom; for matter *is*, and can only change form and position.

We have ceased to consider heat and light as matter, and it appears that all other so-called imponderables must follow these.

Heat has been considered as the internal excitation of motion in matter in general, and light as the excitation of motion in a rare medium called Æther. It is possible that this may not express the true nature of light and heat; but at least this much is settled, that light and heat are not matter, but force in act. In like manner I shall for the present call electricity and magnetism two different forms of force, for I am constrained to think of them as such.

By this means electric and magnetic induction will be reduced to a correspondence with mechanics. This is another reason why I prefer to speak of electricity and magnetism as force; for I have an impression that any scientific proposition or statement which cannot be translated into mechanical language is somehow not in accordance with facts.

The mechanical conditions of matter being the basis upon which all our knowledge is built; all our other knowledge must correspond to, and at least take the mechanical form of expression. Besides, the mechanical relations of things form the most exact part of our knowledge. In fact it is only in form and number that we have yet attained to an exact science.

ELECTRIC AND MAGNETIC CONDUCTION.

Electric conduction is considered, nay, I think, is proved beyond doubt, to be the vibration or gyration of the molecules of the conducting body, as light is of the æther, and sound of the air.

A sphere of magnetic force is the symmetrical arrangement of some medium in a vortical gyre. This is shown to us by means of iron-filings, which are arranged as meridianals; but a spiral current of electricity is necessary to produce polarity in iron, or, at least, a tangent to such a spiral, which is at right angles to such polar direction; therefore, the real magnetic sphere is in spirals, or, if complete, a vortical of spirals. This is so whether it be the sphere of an electro-magnet or a permanent magnet. This sphere can be excited in and around all substances indifferently, in air or in a vacuum—with the exception of two or three substances, which are called paramagnetics. These are magnetic conductors by pre-eminence, of which iron is the best, as silver is of electricity.

These conductors of electricity and magnetism are diametrically opposite in effect. The one needs to be insulated by a bad conductor; but the other cannot be insulated, nor does it require it, And these facts point to this conclusion: that electric action is a molecular action of particular substances, and magnetism of a general sphere or medium.

The electrical force seems to move in all directions, according to the form of the conductor; but the magnetic moves only in regular spirals. Because of this latter fact the electric conductor must be arranged in regular spirals to induce the full amount of magnetic force in iron, or to excite without iron a perfect magnetic sphere of force, and also to obtain the full amount of electric induction from such a magnetic sphere of force.

MAGNETIC EXCITATION.

If we wish to excite the magnetic force in iron, by means of electricity, we must pass a spiral current of electricity around it. Upon th[illegible] Ampere's theory of the magnet was probably based.

He, a[illegible] oned from the form of the electric current necessary to produce an electro-magnet to the molecular currents necessary to produce a permanent magnet; and these molceular currents he supposed to be electric also; but this last supposition involves the necessity of another supposition, namely, that electric currents are continually gyrating through the steel. However, as a general theory, leaving out these unproved suppositions, it appears to cover all the facts that have yet been recorded. A helix of insulated wire, enclosing an iron core, not only makes that iron a magnet when electrically excited, but is itself a magnet, and has a sphere of magnetic lines of force surrounding it, though there be no iron within.

This induced sphere of magnetic lines of force extends much beyond the exciting helix: the more intense the electric excitement, the more extended is the sphere.

ELECTRIC INDUCTION.

If another helix of insulated wire surround the exciting helix within the sphere of magnetic force, then in this outer helix there will be an electric current induced on the instant that the iron core is magnetically excited, but in the opposite direction to that from the battery which flows through the inner helix. Also when the magnetism ceases in the core there will be an electric current induced, but in the same direction as that in the inner helix. Now, why have we two electric inductions for one magnetic excitation? I think, to explain this, we must have recourse to Professor Faraday's moving wire amongst the lines of force of a permanent magnet. Here we have the lines of force and the conducting wire; but there is no electric induction without mechanical motion. Three conditions appear to be necessary: a sphere of magnetic force a conductor, and the motion of that conductor across these lines of force. But in electro-magnetic induction, the conductor is not moved across the lines of force. Neither is it in magnetic-electro induction when the permanent magnet is caused to move in front of the helices; and in both these cases the induction is double. Now, it appears, that there is only one other way in which the necessary conditions can be fulfilled, and that is, that the lines of force must move across the conductor. If this be granted, as I think it must, then the two inductions are explained. There must be one induction on the projection of the lines across the conductor, and another on their recession; and these inductions must necessarily be in opposite directions. From this there follows two consequences, that these lines of force are not in a state of fluxion except on their projection and recession; and that the electricity that excites the magnetism is in a continuous state of fluxion from the completion of its circuit to its disruption.

Not only are the molecules of iron brought into the symmetrical vortical form, but the general sphere of magnetism also, whether there be a magnetic metal present or not, and these are held in that form only whilst the electricity flows; when it ceases they revert to their neutral state. The molecules of steel, on the contrary, when once brought into that form remain in it, and sustain the external sphere of magnetic force. This magnetic force is static, no motion is apparent whilst it is maintained constant; but whilst the electric circuit is maintained constant there is in it continued action; this is proved by electrolysis. On the contrary the motion of the magnetic sphere is only on its projection and recession; that is, on its flowing into the induced vortical, and on its receding as the vortical subsides.

The projection and recession of the lines of force are the same in electro-magnetic induction and in magneto-electric induction. In the former case the core is excited by electricity, in the latter by a permanent magnet; but in all cases there must be the three conditions—a sphere of magnetic force, a conductor and motion—or there will be no induction.

CONFIRMATIONS FROM MECHANICS.

Descending now to simple mechanics for explanations and

confirmations. Taking the form of our exciting electric current (or, which is the same thing, the form of the conductor), which in mechanics corresponds to the screw or spiral incline. If two screws move, the one within the other, then the motions of the two will be in opposite directions. Now, it is not the electric current in the inner exciting spiral that induces directly the current in the outer spiral, but by an intermediate—the magnetic sphere; for it is this sphere which moves within and amongst the external spirals, there being no other nexus between the inner and outer spirals, the two being electrically insulated; but the magnetic sphere penetrates all things. Besides, if the electric induction were produced directly by the inner electric current, then, according to mechanical induction, the induced current would be continuous with the exciting current; but it is not, it oscillates with the projection and recession of the magnetic sphere.

Again, if the magnetic spiral were intact before the completion of the inner electric circuit, and not projected by it, then motion only would be induced in it, and that in a contrary direction to the exciting electric current, and it would be continuous, then the induced electric current would be in an opposite direction to that, and also continuous; for every effect must continue whilst its exciting cause continues. But these two conclusions are contrary to the fact, therefore the supposition is contrary to the fact; the magnetic sphere being projected by the inducing electric current, consequently inducing the outer electric current in an opposite direction to itself and to the inducing electric current.

In magnetising the core of an induction coil the magnetism must proceed gradually from the positive to the negative, as the exciting electric current does. It is too instantaneous for us to prove this by experiment; but we can clearly see it must be so from the nature of the case. This then will give an induction according to mechanics, in an opposite direction to the inducing current; and, of consequence, on the recession of the magnetic sphere the direction of the induction will be changed. By mechanics, then, not only the fact of induction is explained, but also the double induction, and the directions of the currents.

THEORETIC SUMMARY.

That the phenomena called electricity and magnetism are two forms of force, which may either be in conatus or in act. If in conatus, then they are in a state of tension; if in act, then in a state of fluxion. Electricity is in conatus when in the static form of excitation, or when the voltaic circuit is not completed. In act when matter highly excited is brought in contact with matter less highly excited, or when the voltaic circuit is completed.

Magnetism is in conatus when the magnetic vortical sphere is held constant by a constant electric current, or by hardened steel or magnetic iron ore, so that the earth magnetism may flow in. In act on its electric projection and recession, or when iron or some other paramagnetic is moved through this sphere.

That Electric Conduction is by certain molecular movements of particular portions of matter. Those wherein this movement is easily excited are called conductors, and those wherein it is with difficulty excited are called insulators.

That Magnetic Conduction is by the symmetrical arrangement into a vortical sphere of spirals of a general medium, which pervades all matter, and holds it in that form for the time being. That particular matter wherein the sphere is easily excited is called paramagnetic, and that wherein it is with more difficulty excited is called diamagnetic. That this sphere can be fixed by means of hardened steel or magnetic iron ore.

That the Magnetic Vortical can be excited by means of spiral currents of electricity, generally, and even by a tangent to such spiral. Also it can be induced by magnetic conduction in paramagnetics.

That the magnetic force is only in a state of fluxion on the projection and recession of this sphere.

That this sphere is projected in the direction of the exciting electric current, and recedes in the opposite direction.

That the electric force is induced on the projection of the magnetic vortical, and also on its recession. That, consequently, for one inducing current there are two induced currents; therefore it would appear, that by induction electric excitation is multiplied.

FINALLY—That these inductions and conversions of force are in strict accordance with the laws of mechanical motion.

APPLICATION OF ELECTRICITY.

When we wish to use the electric force we excite it by chemical or mechanical action, but most generally by chemical action: as for Telegraphy and Electro-Metallurgy. If for Telegraphy, then electricity of considerable *intensity* is required. To obtain this intensity a series of successive elements must be used, and these should be insulated from each other, that there may not be any useless action. Besides, to insure this, the elements must be perfectly pure also: that is, the positive element must be free from any matter that is negative to it, and the negative free from any matter that is positive to it.

All these conditions can be fulfilled. All the elements for a battery can be made pure; but they will have to be specially made so: the materials of ordinary commerce are not so. Given our materials pure and our cells perfectly insulated, still so great a number as is frequently required is not easily kept in order. Frequently as many as 500 cells are required in one battery, and in a large telegraph office five or six thousand must be kept ready for use. In such a number the waste from local action and want of insulation must be considerable, leaving out the first cost, which is not a small sum. But the great and never-ending difficulty is to keep them in working order It is the universal expression of all who have to do with batteries, that "they are a great nuisance." There are two ways of dispensing with these enormous voltaic batteries—either by using magneto-electric or electro-magnetic induction machines. The magneto is not self-acting, and this is detrimental to it. The electro-magnetic induction machine is not only much more powerful, but can be made self-acting.

THE INDUCTION MACHINE.

In the machine here exhibited this condition is fulfilled. Here are four induction coils with iron cores arranged as two electro-magnets, with their like poles facing each other, and at a small distance apart; between these a light armature vibrates, which drives a longitudinal rod, and this rod actuates the commutator, which delivers the two opposite induced currents in one; it also actuates the break-piece, which throws the battery current from one pair of coils to the other, thereby producing electric induction in the outer coils of the two pairs of spools alternately.

This induced electricity should, by theory, be equal in force at least to the indueing current; for if a certain amount of force be exerted to produce an effect, that effect is simply the embodyment of the force exerted in another form.

The only limit to the induction is the bounds of the sphere of magnetic force, or rather the useful limit will be within the point where the resistance of one layer of the conductor is equal to the force of the magnetic sphere at that point. From this it would appear that the induced electricity would come short of the inducing electricity; but there is another consideration not taken into account, namely, that there are two electric inductions for one magnetic induction. Let us see how this will affect our machine. A current of electricity is sent

through the inducing coils of one pair of spools, and produces magnetic spheres in and about the iron cores. These spheres, on their projection, produce theoretically an induced current of electricity equal in amount to that which produced them, and without any further expenditure of inducing electricity, there is another induction of equal amount on the recession of the magnetic sphere. This looks like the production of something out of nothing, which is impossible. But if looked into more closely, it will be seen that electricity does not in this case produce the magnetic force, and I suspect it never does. It simply induces a particular spiral or vortical sphere, into which the general magnetic sphere flows: this is proved to be so by the following considerations. If a piece of iron be brought into the sphere of a magnet that sphere converges and concentrates itself in it, the molecules of the iron being brought into order by the force of the magnet. Further, if a steel bar be magnetised by means of an electric current, it retains its magnetism for ever. Now, to produce a similar continued magnetism in soft iron would be at the expenditure of an infinity of electric force. Whence then comes that magnetism if not from the general Earth sphere,—certainly not from any other known force. Clearly, then, the electricity simply brought the molecules of the steel into order, and did not produce the magnetism. Similarly, then, all magnetic spheres are produced; therefore, in saying that we have two induced currents, each theoretically equal to the inducing current, we do not state an impossibility; but simply, that we can utilise by suitable mechanical contrivance a portion of that store of Earth magnetism, which to us is inexhaustible. This is the theoretic result; but, as in the theory of heat, the practical result will come short of it, but it is not liable to so many deductions. The principal deductions are these: the resistance of the conductor, and the induction which takes place in the inducing coil. Beyond these I think there is not any other. After these deductions, I am convinced, from experience, that there is a great gain on the inducing electricity expended, and in this machine there seems to me to be proof positive that it is so; for if the induced current of electricity be allowed to flow through the machine without external resistance it overpowers the battery current, reverses the magnetism in the cores, and arrests the motion of the machine, which could not be the case if the currents were simply equal; for the external helix being much further from the cores than the internal, the current in them must have a much smaller magnetical effect, and could produce no arrestation of the machine, which at present it does.

Beyond this there is this advantage, that you can take the induced electricity either in quantity or intensity simply by varying the thickness of the wire in the external coil. Hitherto induced electricity has not been used where a continuous current has been required; because till now there has been no machine suitable to reverse the alternate currents, which was also self-acting. The quantity and intensity of the current of this machine are governed by the same law as those of a battery.

It has been tested against a 60-cell Daniel's battery, the tension of which on a Peltier's electrometer was 12°, and the quantity on the galvanometer was 45°. The tension of the machine was $8\frac{1}{2}$°, and the quantity 35°. The ratio of the tensions will be as $\sqrt{12}:\sqrt{8\frac{1}{2}}$, or about 7 : 6, and the quantities as 45 : 35, or 9 : 7, so that the machine is slightly more intense for the quantity than the battery.

It has been tried on a line of telegraph between London and Dover, and it works the needle instrument very satisfactorily. To work the Morse instrument it requires a reversing key and shunt to send a slight reversal through the instrument. It will decompose nitrate of manganese through 600 miles of resistance.

For electro-deposit a large series of depositing cells is required. I have tried [illegible] 50, and at the same time a resistance of 20 miles of [illegible] wire in circuit. The resistance of these 50 cells was under a mile of such wire; therefore it would have deposited an equal quantity in each of 1,000 cells.

In five hours it deposited in each cell $3\frac{3}{4}$ grs.; for 1,000 cells this is 3,750 grs., and for one day of ten hours 7,500 grs., which is more than 1 lb. avoirdupois. The metal deposited was copper; therefore it would deposit much more silver, the equivalent of silver being 108—that of copper 31·7. The machine was driven by a 6-cell battery, each cell containing 18 square inches of zinc.

Beyond these applications, when wound with fine wire it is a much more efficient philosophical instrument than a Rhumkorf's coil, for the Rhumkorf gives only sparks; but it will give a stream of light, and in this form can be used for the electric light. I state this last from reason, and not from experiment.

The Advantages Obtained.

That this machine with a few cells can be made equal to a battery composed of any number of cells in series without the loss by leakage and local action, which is inevitable in large batteries, to say nothing of the trouble that is saved. These are great advantages, if there were no augmentation of electricity by induction. That, therefore, it is not only much more convenient, but more economical than batteries for scientific purposes and for use in the arts. Its small battery being easily kept in order and quickly put in action, and the machine itself being simple in construction is not liable to get out of order, and will not wear out for very many years.

[In the discussion which followed the reading of the foregoing paper, Mr. Fleeming Jenkin, one of the secretaries of the section, explained that magnetic machines had been constructed which, by passing magnets across the coils in the coils across the magnets, elicited streams of different degrees of intensity; but in the present machine Mr. Thompson used a battery in one part of the machine which, he said, should induce currents of varying quantity in another part, and which currents might be so combined as to be used in many experimental ways more convenient than could be obtained from the ordinary batteries. This machine, Mr. Thompson said, was thoroughly self-acting, not requiring the intervention of clockwork or any other driving force; and instead of using a battery of twenty or one hundred cells, they could by this machine obtain equal effects from five cells, and for one cell effects which in ordinary machines would require twenty cells, and by combination other effects which would require in ordinary circumstances one hundred cells.]

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

VIII.

A.D. 1832, 1833.—Dr. Schulthess, in December, 1832, delivered a lecture before the Philosophical Society of Zurich, in which he asks, "Whether such a power as that which is obtained by interrupting the electric current, and then restoring it, could not be applied in mechanical science?" and in January, 1833, he exhibited before the Mechanics' Society a machine in which this had been so far accomplished. (See *Practical Mechanic and Engineers' Magazine*, November, 1842, p. 48.)

A.D. 1833.—Mr. Saxton, in 1833, submitted his magneto-electric machine to the British Association; the coils rotate in front of the poles of a fixed magnet. (See Highton's *Electric Telegraph*, p. 17.)

A.D. 1833.—Gauss and Weber invented their electric telegraph in 1833. "One wire and one needle only were needed. The power employed was magneto-electricity." (See Highton's *Electric Telegraph*, p. 39.)

A.D. 1833.—Thomas Davenport, in 1833, suggested electro-motion. (See *Encyclopædia Britannica*, 7th edition, art. Voltaic Electricity, p. 687.)

A.D. 1833.—Sturgeon, in 1832, exhibited an electro-magnetic

engine which was capable of pumping water, sawing wood, and performing other mechanical operations. (See Dodd's *Industrial Application of Electricity*, p. 8.)

A.D. 1833.—M. Marianini, in 1833, relates a number of cases of paralysis treated by voltaic electricity. The application is by shocks, which are made to pass through the affected part, sometimes in one direction and sometimes in the opposite. In one case cited, a battery of from 58 to 75 pairs was employed. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 589, 590.)

A.D. 1834.—Dr. Faraday, in 1834, demonstrated the definite nature of electro-chemical or electrolytic decomposition, and showed that the chemical equivalents of bodies were also their electro-chemical equivalents; he also discovered that the chemical power of an electric current is in direct proportion to the quantity of electricity that circulates. (See Faraday's *Experimental Researches in Electricity*, 7th series, section 7; also *Philosophical Transactions*, 1834; also Bakewell's *Electric Science*, pp. 124-127.)

A.D. 1834.—Dr. Faraday, in 1834, established the principle that the quantity of electricity evolved from a galvanic battery depends upon the size of the plates and the intensity of the electric current upon the number of pairs. (See Faraday's *Experimental Researches*, 8th series, paragraph 991; also Dr. Golding Bird's *Natural Philosophy*, p. 227.)

A.D. 1834.—Dr. Faraday, in 1834, applied the voltameter to test the quantity of a voltaic current. (See *Philosophical Transactions*, 1834, pp. 704-741.)

A.D. 1834.—Sir William Snow Harris, between the years 1834 and 1839, applied the principle of his hydrostatic magnetometer to the electrometer. (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 85.)

A.D. 1834.—Sir William Snow Harris, in 1834, applied the common scale beam to measure electric forces. (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 86.)

A.D. 1834.—Professor Wheatstone, in 1834, found the velocity of electricity to be 200,000 miles in a second, upon the double-fluid theory of electricity, or upon the single-fluid theory 576,000 miles per second. "This fact was deduced by catching in a mirror, whilst revolving on a horizontal axis at the rate of 800 times in a second, three electrical sparks produced by the discharge of an electrical jar in an interrupted circuit, the interruptions being at each end and in the middle of the conducting wire." In this experiment the centre spark fell out of the line of the other sparks by half a degree of the circle." (See Sir W. Snow Harris' *Rudimentary Electricity*, p. 123.)

A.D. 1834.—Mr. Henry Bessemer, of Camden Town, about the year 1834, electro-deposited "copper on lead castings so as to produce antique heads in relief for mantelpiece ornaments. (See *Encyclopædia Britannica*, 8th edition, art. Electrotypie, p. 627; also *Mechanics' Magazine*, February, 1844, p. 73.)

A.D. 1834.—Professor Jacobi, in November, 1834, laid before "the Academy of Sciences of Paris a note upon a new electro-magnetic-apparatus." (See *Practical Mechanic and Engineers' Magazine*, November, 1842, p. 48.)

A.D. 1834.—Mr. E. M. Clarke, in 1834, invented a magneto-electric machine in which coils rotate at the side of the magnet. Different armatures were used for intensity and quantity currents. (See *Encyclopædia Britannica*, 7th edition, art. Voltaic Electricity, p. 693.)

A.D 1834.—Dr. Faraday, in December, 1834, experimented on the induction of a galvanic current upon itself. Professor Henry, of Princeton, United States, M. Abria, and M. Wartmann, also laboured in the same field of science. (See Faraday's *Experimental Researches in Electricity*, Vol. I., pp. 322-343; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 393-402.)

A.D. 1835.—Forbes, in 1835, employed a thermo-multiplier to measure the heat caused by the concentration of moonlight 3,000 times; the result was that no trace of heating was observed. (See *London and Edinburgh Philosophical Magazine*, Vol. VI., p. 138; also Gmelin's *Handbook of Chemistry*, Vol. I., p. 166.)

A.D. 1836.—M. Schoenbein, in 1836, made his celebrated investigations on the negative polarity induced upon iron, which renders it unattackable by acids or "passive." Dr. Faraday and M. Beetz immediately followed up these experiments, and proved that passive iron was covered with a pellicle of oxide. Mr. Andrews demonstrated the passivity of bismuth, M. Beetz that of nickel, and M. Nicklès that of cobalt. Heat, and electrolytical and chemical action under certain circumstances, are the means of rendering the above metals passive. (See Faraday's *Experimental Researches in Electricity*, Vol. II., pp. 234 and 239; and De la Rive's *Treatise on Electricity*, Vol. II., pp. 738-744.)

A.D. 1836.—Sir William Snow Harris, in 1836, published a description of "the bifilar balance electrometer," invented by himself. (See *Philosophical Transactions*, 1836; also Sir W. Snow Harris' *Rudimentary Electricity*, p. 83.)

A.D. 1836.—Chevalier Antinori, of Florence, in 1836, "by connecting a thermo-electric battery with a helix of insulated copper wire, about 500 feet in length, obtained on breaking contact, a vivid spark from the induced or secondary current produced by the passage of the primary thermo-electric current." (See Dr. Golding Bird's *Natural Philosophy*, p. 280.)

A.D. 1836.—Professor Daniell, in 1836, published an account of his "constant" galvanic battery in the "Philosophical Transactions." In this double-fluid battery the elements are, copper, acid solution of sulphate of copper, dilute sulphuric acid, and amalgamated zinc; a copper cylinder surrounds a bolt of zinc. A battery of 70 cells fused titanium and heated 16 feet 4 inches of No. 20 platinum wire. (See *Encyclopædia Britannica*, 7th edition, art. Voltaic Electricity, pp. 669-671; also Gmelin's *Handbook of Chemistry*, pp. 393 and 421; also Bakewell's *Electric Science*, pp. 43, 106, 107.)

A.D. 1836.—Mr. Mullins brought forward his "sustaining" galvanic battery in 1836. This double-fluid battery consists of copper, acid solution of sulphate of copper, solution of chloride of ammonium, and unamalgamated zinc; the zinc surrounds the copper. (See *Philosophical Magazine*, 1836, p. 283; also *Encyclopædia Britannica*, 7th edition, art. Voltaic Electricity, p. 671; also Gmelin's *Handbook of Chemistry*, Vol. I., p. 393; also *Practical Mechanic and Engineers' Magazine*, September, 1842, pp. 484, 485.)

A.D. 1836.—De la Rue published a description of his galvanic battery in 1836. This was a peculiar form of Daniell's battery in which all the cells could be filled at one time. (See *Philosophical Magazine*, 1836; also Smee's *Electro-metallurgy*, History, p. 18.)

A.D. 1836.—De la Rue, in 1836, published the following remarks in reference to the properties of his modification of Daniell's galvanic battery:—"The copper plate is also covered with a coating of metallic copper, which is continually being deposited; and so perfect is the sheet of copper thus formed, that, being stripped off, it has the counterpart of every scratch of the plate on which it is deposited." This is interesting in relation to electro-metallurgy. (See *Philosophical Magazine*, 1836; also Smee's *Electro-metallurgy*, History, p. 18.)

A.D. 1836.—Messrs. Taquin and Ettieyhausen established their electric telegraph in Vienna in 1836. The wires were partly suspended in the air and partly buried in the earth. (See Highton's *Electric Telegraph*, pp. 39 and 57.)

A.D. 1836.—Mr. Andrew Crosse, in 1836, showed his electrical arrangements to Sir Richard Phillips and other members of the British Association. These arrangements consisted of 2,500 voltaic pairs excited only by pure water, and principally employed to produce minerals artificially; also of one-third of a mile of exploring wire to collect atmospheric electricity, and suitable apparatus for its discharge and for carrying on gigantic experiments with it. Professor Sedgwick saw the atmospheric apparatus in the year 1819. Crosse also used a condenser or electrical battery, in which plates of mica separated the polar surfaces. (See Sturgeon's *Annals of Electricity*, &c., Vol. I., January, 1837, pp. 135-145; also Noad's *Manual of Electricity*, pp. 257-259.)

A.D. 1837.—Mr. Andrew Crosse, in 1837, found insects (the "electrical acarus") produced in his apparatus for electro-crystallization. (See Sturgeon's *Annals of Electricity*, &c., Vol. I., April, 1837, pp. 242-244.)

A.D. 1837.—Steinheil, in 1837, made the counting of the number of motions of the magnetic needle the basis of his telegraphic alphabet. (See Highton's *Electric Telegraph*, p. 137.)

A.D. 1837.—Steinheil, in 1837, used wires suspended in the air, and buried in the ground, for an electric telegraph. (See Highton's *Electric Telegraph*, p. 137.)

A.D. 1837.—Steinheil invented his electric telegraph in 1837. "This telegraph required only one wire and one or two magnetic needles. The power used was magneto-electricity, Steinheil had a printing telegraph as well as a means of telegraphing by sounds produced by electric apparatus striking bells." The signals of the printing or marking telegraph were made by furnishing the needles with small tubes containing ink; by the motions of the needles "dots were made on paper properly moved in front of them by wound-up mechanism; one needle making dots in one line, and the

other needle making dots in a line underneath the former." (See Highton's *Electric Telegraph*, pp. 39 and 57-60.)

A.D. 1837.—Masson, in 1837, erected a telegraph at Caen, in which magneto-electricity was made to operate upon magnetic needles. (See Highton's *Electric Telegraph*, pp. 40 and 60-62.)

A.D. 1837.—Dr. Andrews, in 1837, constructed a thermo-electric battery of platinum wires and fused salts. (See *London, Edinburgh, and Dublin Philosophical Magazine*, June, 1837, Vol. X., p. 433.)

A.D. 1837.—M. Becquerel, in 1837, invented his electro-magnetic balance. By means of this instrument the proportional intensity of galvanic currents is ascertained, weights being placed in a scale pan attached to the moveable soft iron core of the electro-magnet sufficient to restore the equilibrium. (See Sturgeon's *Annals of Electricity*, &c., Vol. I., July, 1837, pp. 398-404; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 339-341.)

A.D. 1837.—Dr. Golding Bird, in 1837, by using a constant galvanic current of low tension, decomposed fluorides of silicon, and the chlorides of potassium, sodium, and ammonium; silicon [silicium?] was thus obtained in a metallic state, and potassium, sodium, and ammonium as amalgams. (See *Philosophical Transactions*, 1837, p. 37; also Dr. Golding Bird's *Natural Philosophy*, p. 240.)

A.D. 1837.—Professor Morse says that the idea of an electric telegraph occurred to him in 1832, but he did not test his telegraph until September, 1837, and the first experiment was made October 2, 1837. In this telegraph a marking lever makes pricks on paper (a pen or pencil was at first used, the lever being actuated by an electro-magnet); one wire only is used. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 75-79; also Highton's *Electric Telegraph*, pp. 60-63.)

A.D. 1837.—Vail, in September, 1837, whilst making the Morse instrument, invented a single-wire printing electric telegraph. A type wheel is moved forward by a clockwork escapement, regulated by a pendulum, on the excitation of an electro-magnet; the paper is pressed against a type wheel, and an impression made of the letter then present. (See Highton's *Electric Telegraph*, pp. 63, 64.)

A.D. 1837.—Mr. Sturgeon, in 1837, published his investigations relating to the thickness of iron suitable for electro-magnets. Some time previous to this date he discovered "that if a bar of *soft iron* be surrounded with coils of wire, and an electric current be transmitted in the same direction through each convolution, that the soft iron bar instantly becomes a magnet, and is capable of attracting other pieces of soft iron or steel, and that it remains magnetic so long as the electric current is passing through the coils: and that as soon as the current ceases the bar instantly loses its magnetic condition, and no longer attracts pieces of adjacent iron or steel." (See Sturgeon's *Annals of Electricity*, &c., Vol. I., October, 1837, pp. 470-484; also Highton's *Electric Telegraph*, p. 27.)

A.D. 1837.—Young's single-fluid galvanic battery was invented in 1837. It consists of zinc and copper plates so arranged that a copper plate comes between two zinc plates, and a zinc plate between two copper plates; the pairs are interlaced. A mixture of dilute sulphuric and nitric acids is used to excite this battery. (See Gmelin's *Handbook of Chemistry*, Vol. I., p. 425; also *Practical Mechanic and Engineers' Magazine*, February, 1842, p. 193.)

A.D. 1838.—Mullins, in 1838, substituted sycamore porous cells (in double-fluid galvanic batteries) for animal membranes. (See Gmelin's *Handbook of Chemistry*, Vol. I., p. 422; also *Practical Mechanic and Engineers' Magazine*, September, 1842, pp. 484, 485, and November, 1842, pp. 43, 44.)

A.D. 1838.—Professor Jacobi, in 1838, "produced a vessel upon the Neva worked by electro-magnets." (See *Abridgments of the Specifications relating to Marine Propulsion*, Part. II., p. 144; also *Times* newspaper, December 26, 1857, p. 9, col. 4; also *Practical Mechanic and Engineers' Magazine*, November, 1842, p. 48.)

A.D. 1838.—M. Amyot's proposal for an electric telegraph was made to the Académie des Sciences on July 2, 1838. In this telegraph it was intended to use a single current and a single needle, "which writes of itself on the paper," the paper being moved by clockwork. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 84, 85.)

A.D. 1838.—Professor Jacobi first announced his "galvanoplastic" process in October, 1838. An allusion to it was published in this country in May, 1839; the paragraph is as follows:—"He has found a method—if we understand our informant rightly—of converting any line, however fine, engraved on copper, into a relief by galvanic process." Jacobi says that his process is applicable to copper-plate engravings, medals, stereotype plates, ornaments, and to making calico-printing blocks and patterns for paper-hangings. (See Smee's *Electro-metallurgy*, History, p. 18; also *Athenæum*, May 4, 1839; also *Mechanics' Magazine*, May 11, 1839, and February 24, 1844, p. 118; also Gmelin's *Handbook of Chemistry*, Vol. I., pp. 502-510.)

A.D. 1838.—Schweigger, in his journal, in 1838, proposes the following modification of Soemmering's electric telegraph:—The use of two galvanic batteries, one weaker than the other, so as to vary the amount of gas evolved in a given time; he proposes also to vary the period of time of the evolution of the gases. The number of wires would be then reduced to two. Printing the letters by means of lamp-black paper, &c., was also suggested. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 64, 65; also Highton's *Electric Telegraph*, pp. 48, 49.)

A.D. 1838.—Mr. J. Dancer, of Liverpool, about 1838, used porous vessels of the thinnest unglazed biscuit ware for galvanic batteries. (See Dr. Golding Bird's *Natural Philosophy*, p. 229; also *Mechanics' Magazine*, February 3, 1844, p. 76.)

A.D. 1839.—Dr. William O'Shaughnessy, at Calcutta, in 1839, made experiments on a small scale to submerge an insulated electric conductor under water; the conductor consisted of copper wire, coated with cotton thread saturated with pitch and tar. (See *Journal of the Society of Arts*, April 23, 1858, p. 351.)

A.D. 1839.—M. Vorsselman de Heer, on the 31st of January, 1839, exhibited an electro-physiological telegraph at a meeting of the Societé de Physique of Deventer. Ten wires are used, and the operator's fingers receive shocks, the signal being determined by the fingers affected; it is also proposed to use secondary currents. (See Poggendorff's *Annalen*, Vol. XLVI., p. 513; also Abbé Moigno's *Triaté de Télégraphic Electrique*, pp. 90-95; also *Journal of the Society of Arts*, April 23, 1858, p. 358.)

A.D. 1839.—Grove's galvanic battery was invented in 1839. In this double-fluid battery the elements are platinum, nitric acid, dilute sulphuric acid, and amalgamated zinc. (See Gmelin's *Handbook of Chemistry*, Vol. I., pp. 391 and 422; also Noad's *Manual of Electricity*, 3rd edition, p. 167.)

A.D. 1839.—Mr. T. Spencer, about the year 1839, in galvanic batteries, substituted a brown packing-paper porous cell for the oxgullet of Daniell's battery; also Glauber's salt or sulphate of zinc for dilute sulphuric acid. (See Gmelin's *Handbook of Chemistry*, Vol. I., p. 422; also *Instructions for the Multiplication of Works of Art in Metal by Voltaic Electricity*, by Thomas Spencer, 8vo., Glasgow, 1840, pp. 59, 60.)

The Application of Electricity to Curative Purposes.—M. Nélaton, whose reputation as a surgeon is European, has recently made a discovery, or rather applied a natural force, to the cure of one of the most painful forms of disease that afflict human nature, and he has just communicated the fact to the Academy of Sciences of Paris. The object is the destruction of tumours by means of the electric current. Polypi and other tumours formed in the natural cavities of the head and of other parts of the body are not only most painful, but their extirpation is attended with the greatest danger, especially when seated in the head. M. Nélaton has given a large amount of attention to this subject, and having arrived at the conclusion that all the means in general use were exceedingly unsatisfactory, resolved to try the effect of electricity. It has been long known that when two needles connected with the poles of a battery are placed in contact with the skin of the human body a slight destruction of the tissue occurs, but little importance was attached to the fact. M. Nélaton, however, conceived the idea of attempting to destroy tumours by inserting the needles in the parasitic mass, and placing them in communication with a powerful voltaic pile. In the first place he experimented on a dog, and he found that when two platinum points connected with a Bunsen battery of nine elements were inserted in the flesh there arose, after the current had been in action for eight or ten minutes, an induration of some extent around the positive needle and a corresponding softening of the parts round the other, with the formation of a white froth, composed of extremely minute bubbles of gas. After some other preliminary experiments, Dr. Nélaton had an opportunity of testing his new mode of operation, to which he gives the name of *electropuncture*, in the case of polypus in the human subject. A young man, a tutor, nineteen years of age, entered into the family of M. Nélaton; he was suffering from a large vascular tumour in the roof of the mouth, which caused him great pain and inconvenience. All the ordinary modes of treatment had been tried without success, when Dr. Nélaton decided on making an experiment with the electric current. Two needles were introduced into the tumour, the pain was slight, and the white frothiness soon made its appearance. The action was continued for ten minutes. The treatment was repeated at intervals of eight and ten days, and maintained, after the first occasion, for only three to five minutes; the polypus began to diminish from the first application, and the patient was cured in four months, without loss of blood, and having suffered little pain. Dr. Nélaton has achieved few more important successes.

ON BOILING WATER.

BY W. GROVE, ESQ., Q.C., F.R.S., M.R.I.

(*Concluded from page* 139.)

A similar experiment was made with melted sulphur, and sulphuretted hydrogen was given off, but not in such quantities as the phosphuretted hydrogen. I tried in vain to carry on these experiments beyond a certain point; the substance became pasty, mixed with platinum from the arc, and, from the difficulty of working with the same freedom as when they were fresh, the glass tubes were always broken after a certain time. Had I time for working on the subject now, I should use the discharge from the Ruhmkorf coil, which had not been invented at the period of these experiments. At a subsequent period, when this discharge was taken in the vacuous receiver of an air-pump from a metallic point to a metallic capsule containing phosphorus, a considerable yellow deposit lined the receiver, which, on testing, turned out to be allotropic phosphorus. No gas is, however, given off. I had an air-pump (described "Phil. Trans.," 1852, p. 101) which enabled me to detect very small quantities of gas, but I could get none. It was in making these experiments that I first detected the striæ in the electric discharge (which have since become a subject of such interesting observations), which are seen, perhaps, more beautifully in this phosphorus vapour than in any other medium, and which cease or become very feeble where the allotropic phosphorus is not produced.

I tried also phosphorus, highly heated by a burning-glass, in an atmosphere of nitrogen, but could eliminate no perceptible quantity of gas, though the phosphorus was changed into the allotropic form.

It is not difficult to understand why gas is not perceptibly eliminated in the last two experiments; the effect is, probably, similar to that described in my paper on the "Decomposition of Water by Heat," where, when the arc or electric spark is taken in aqueous vapour, a minute bubble of oxyhydrogen gas is freed and disseminated through the vapour, recombination being probably prevented by this dilution; but, however long the experiment may be continued, no increased quantity of the gas is obtained, all beyond this minute quantity being recombined. If, however, the bubble of gas be collected, by allowing the vapour to cool, and then expelled, a fresh portion is decomposed, and so on.

So with the phosphorus in the experiments in the air-pump and with the burning-glass; if any gas is liberated it is probably immediately recombined with the phosphorus; possibly a minute residuum might escape recombination, but the circumstances of the experiment did not admit of this being collected, as the gas was with the aqueous vapour.

When, on the other hand, the gas freed is immediately cut off from the source of heat, as when the spark is taken in liquids, an indefinite quantity can be obtained.

Decomposition and the elimination of gas may thus take place by the application of intense heat to a point in a liquid, or also in gas or vapours; but in the latter case it is more likely to be masked by the quantity of gas or vapour through which it is disseminated.

I believe there are very few gases in which some alteration does not take place by the application of the intense heat of the voltaic arc or electric spark. If the arc be taken between the platinum points in dry oxygen gas over mercury, the gas diminishes indefinitely, until the mercury rises, and, by reaching the point where the arc takes place, puts an end to the experiment. I have caused as much as a cubic inch of oxygen to disappear by this means. I at one time thought this was due to the oxidation of the platinum, but the high heat renders this improbable, and the deposit formed on the interior of the glass tube, in which the experiment is made, has all the properties of platinum-black. So if the spark from a Ruhmkorf coil be taken in the vapour of water for several days, a portion of gas is freed which is pure hydrogen, the oxygen freed being probably changed into ozone, and dissolved by the water in this case, while in the former it combined with the mercury.

I have alluded to the eudiometer by which I analyzed the gases obtained in these experiments. It was formed simply of a tube of glass, frequently not above 2½ millimetres in diameter, with a loop of wire hermetically sealed into one end, the other having an open bell mouth. By a platinum wire a small bubble of the gas to be examined could be got up through water or mercury into the closed end of the tube, and, by the addition of a bubble of oxygen or hydrogen gas, a very accurate analysis of very minute quantities of gas could be made. I have analysed by this means quantities no larger than a partridge-shot.

I need hardly allude to results on the compound liquids, such as oils and hydrocarbons, as the fact that permanent gas is given off in boiling such liquids would not be unexpected; but the above experiments seem to show that boiling is by no means necessarily the phenomenon that has generally been supposed, viz., a separation of cohesion in the molecules of a liquid from distension by heat. I believe, from the close investigation I made into the subject, that (except with the metals, on which there is no evidence) no one has seen the phenomenon of pure boiling without permanent gas being freed, and that what is ordinarily termed boiling arises from the extrication of a bubble of permanent gas either by chemical decomposition of the liquid, or by the separation of some gas associated in minute quantity with the liquid, and from which human means have hitherto failed to purge it; this bubble once extricated, the vapour of the liquid expands to it, or, to use the appropriate phrase of M. Donny, the liquid evaporates against the surface of the gas.

My experiments are, in a certain sense, the complement of his. He showed that the temperature of the boiling point was raised in some proportion as water was deprived of air, and that, under such circumstances, the boiling took place by *soubresauts*. I have, I trust, shown that when the vapour liberated by boiling is allowed to condense, it does not altogether collapse into a liquid, but leaves a residual bubble of permanent gas, and that at a certain point this evolution becomes uniform.

Boiling, then, is not the result of merely raising a liquid to a given temperature, it is something much more complex.

One might suppose that with a compound liquid the initial bubble by which evaporation is enabled to take place, might, if all foreign gas were or could be extracted, be formed by decomposition of the liquid; but this could not be the case with an elementary liquid; whence, the oxygen from bromine or the hydrogen from phosphorus and sulphur?

As with the nitrogen in water, it may be that a minute portion of oxygen, hydrogen, or of water, is inseparable from these substances, and that if boiled away to absolute dryness, a minute portion of gas would be left for each ebullition.

With water there seems a point at which the temperature of ebullition and the quantity of nitrogen yielded become uniform, though the latter is excessively minute.

The circumstances of the experiments with bromine, phosphorus, and sulphur, did not permit me to push the experiment so far as was done with water; but as far as it went the result was similar.

When an intense heat, such as that from the electric spark or voltaic arc is applied to permanent gas, there are, in the greater number of cases, signs either of chemical decomposition or of molecular change; thus compound gases, such as hydrocarbons, ammonia, the oxides of nitrogen, and many others are decomposed. Phosphorus in vapour is changed to allotropic phosphorus, oxygen to ozone, which, according to present experience, may be viewed as allotropic oxygen. There may be many cases where, as with aqueous vapour, a small portion only is decomposed, and this may be so masked by the volume of undecomposed gas as to escape detection. If, for instance, the vapour of water were uncondensible, the fact that a portion of it is decomposed by the electric spark or ignited platinum would not have been observed.

All these facts show that the effect of intense heat applied to liquids and gases is much less simple, and presents greater interest to the chemist, than has generally been supposed. In far the greater number of cases, possibly in all, it is not mere expansion into vapour which is produced by intense heat, but there is a chemical or molecular change. Had circumstances permitted, I should have carried these experiments further, and endeavoured to find *experimentum crucis* on the subject. There are difficulties with such substances as bromine, phosphorus, &c., arising from their action on the substances used to contain and heat them, which are not easy to vanquish, and those who may feel inclined to repeat my experiments will find these difficulties greater than they appear in narration, but I do not think they are insuperable, and hope that, in the hands of those who are fortunate enough to have time at their disposal, they may be overcome.

To completely isolate a substance from the surrounding air, and yet be able to experiment on it, is far more difficult than is generally supposed. The air-pump is but a rude mode for such experiments as are here detailed.

Caoutchoic joints are out of the question. Even platinum wires carefully sealed into glass, though, as far as I have been able to

observe, forming a joint which will not allow gas to pass, yet it is one through which liquids will effect a passage, at all events when the wires are repeatedly heated.

In some experiments with the ignited platinum wire hermetically sealed into a tube of glass, the end of the tube containing the platinum wire was placed in a larger tube of oil, to lessen the risk of cracking the glass. After some days experimenting, though the sealing remained perfect, a slight portion of carbon was found in the interior liquid. This does not affect the results of my experiments, as I repeated them with glass tubes closed at the end, and platinum wires, and also without the oil-bath, but it shows how difficult it is to exclude sources of error. When water has been deprived of air to the greatest practicable extent it becomes very avid for air. The following experiment is an instance of this:—A single pair of the gas battery, the liquid in which was cut off from the external air by a greased glass stopper, having one tube filled with water, the other with hydrogen; the platinized platinum plates in each of these tubes were connected with a galvanometer, and a deflection took place from the reaction of the hydrogen on the air dissolved from the water. After a time the deflection abated, and the needle returned to zero, all the oxygen of the air having become combined with the hydrogen. If now the stopper were taken out, a deflection of the galvanometric needle immediately took place, showing that the air rapidly enters the water as water would a sponge. Absolute chemical purity in the ingredients is a matter, for refined experiments, almost unattainable. The more delicate the test, the more some minute residual product is detected. It would seem (to put the proposition in a somewhat exaggerated form) that in Nature everything is to be found in anything if we carefully look for it.

I have indicated the above sources of error to show the close pursuit that is necessary when looking for these minute residual phenomena. Enough has, I trust, been shown in the above experiments to lead to the conclusion that hitherto simple boiling, in the sense of a liquid being expanded by heat into its vapour, without being decomposed or having permanent gas eliminated from it, is a thing unknown. Whether such boiling *can* take place, may be regarded as an open question, though I incline to think it cannot; that if water, for instance, could be absolutely deprived of nitrogen, it would not boil until some portion of it was decomposed; that the physical severance of the molecules by heat is also a chemical severance. If there be anything in this theoretic view, there is great promise of important results on elementary liquids, if the difficulties to which I have alluded can be got over.

The constant appearance of nitrogen in water, when boiled off out of contact with the air almost to the last drop, is a matter well worthy of investigation. I will not speculate on what possible chemical connexion there may be between air and water. The preponderance of these two substances on the surface of our planet, and the probability that nitrogen is not the inert diluent in respiration that is generally supposed, might give rise to not irrational conjectures on some unknown bond between air and water. But it would be rash to announce any theory on such a subject; better to test any guess one may make by experiment, than to mislead by theory without sufficient data, or to lessen the value of facts by connecting them with erroneous hypotheses.

PAPERS ON TELEGRAPHY READ AT THE MEETING OF THE BRITISH ASSOCIATION, HELD AT BATH.

ON SUBMARINE TELEGRAPHY.

On Friday, the 16th instant, Captain Selwyn read an interesting paper on the above subject, of which the following is an abstract:—The subject to which I ask your attention, is one which is full of promise, in the aid which may be given by it to the further development and more rapid increase of that social science, which is the peculiar care of this Association. I feel sure, therefore, that I shall not in vain solicit your indulgence, while I endeavour, however feebly, to aid the progress of submarine telegraphy, by pointing out possible or probable causes of the failure and loss which have hitherto been lamentably prominent features in these great enterprises for the establishment of per oceanic communication by means of electricity. It is evident that, although it may suit other powers to construct at great expense, and with many uncertainties, telegraphic wires over vast continents—wires which will no doubt some day connect the old and new worlds by principally overland system, yet that Great Britain, whose position among the nations, if not her very existence, depends on her retention of the empire of the seas, and of rapid communication with her colonies, can never be satisfied, if the nerve-like ramifications of her telegraphic system are, at any important point, entirely in the power of a foreign potentate. Therefore, the means by which electricity can be made to traverse the ocean depths, remote from chance of injury by foemen, except near the shore; where British seamen may be able to protect it, deserve even more attention in Great Britain than in any other country, and accordingly we find that a very large proportion of the submarine telegraphic cables which have hitherto been laid, or attempted, have been either planned by British energy, or strongly supported by British capital; and almost all the most important lines owe everything to these sources. There is, in short, no nation to which submarine telegraphy may not be of value, but to Great Britain it is of vital importance. Nothing has been more startling and disagreeable than the repeated failures which have, unfortunately, characterised the progress of submarine telegraphy. It seemed scarcely possible that with the names of so many engineers of acknowledged talent, with such capitalists as those who embarked in the enterprise, not only the idea, but the stern fact of repeated failures should be associated. Yet this has been the case, and I have to record a melancholy waste of capital and time, for the last ten years, in what I cannot but consider as misdirected efforts to do the right thing the wrong way. There is not the slightest reason to doubt that gutta-percha, properly laid at the bottom of the sea, in whatever depth, is a perfect and reliable insulator of electricity. A convincing proof of the durability of gutta-percha in salt water, is to be found in the fact, that many of the shallow water cables have been down for a sufficient period, ranging from eight to twelve years, to give the certainty that had there been any such disposition to decay as as was at one time feared, it would long ere this have shown itself. To what causes then are we to attribute the failures which every one laments? I answer, faulty mechanical construction of the cable and faulty mechanical arrangements for its deposition on the bed of the ocean. I tell you, engineers, that you have made a weak rope, and that you handle it wrongly on the ocean. For what reason is it a weak rope? The life of the cable, that which must not be injured in any case, is the copper wire that conveys the electricity; a stretching of this, even to the extent of one in a hundred (which, be it recollected, means, perhaps, one mile in a hundred), cannot for an instant be admitted. Yet this wire is placed in the centre of a comparatively soft and absolutely weak core, and surrounded with spirals of iron or steel by way of giving strength. The axiom of mechanics, which is here transgressed, is this—in any structure composed of spirals in combination with straight lines, any strain must first be borne by the straight lines, and elongation will take place at the limit of tensile strength. To this there is but one exception of this part of the fabric, namely, when spirals surround closely an absolutely hard straight line. The insulator which I should prefer, while admitting and fully recognising the merits of gutta-percha, is the compound of Mr. John Macintosh, of which I can confidently affirm that it will be found fully one-half cheaper than either gutta-percha or India-rubber, and nearly as much superior to either gum, whether in goodness of insulation or lowness of inductive capacity. It has too the valuable property of being absolutely indestructible either in air or earth, as well as in water. The low price of this compound is due to the fact that it is mainly composed of paraffin, forming a substance whose cheapness, insulating properties, and lowness of inductive capacity need only to be generally known to secure its adoption. No company can long afford to pay a double price for a worse material, and if, as I hope may be the case, the new Atlantic cable be laid safely next year, the demand for deep-sea cables which would be sure to follow any such success will speedily bring to the front the best and cheapest insulator. The profits of a single Atlantic cable, once laid, may be safely estimated at £600,000 per annum, even on a very low speed of transmission; and it is certain that many cables would be required to fulfil the demand for rapid and certain communication with the New World. With regard to the route which it is advisable to pursue, I am happy to say that recent discoveries of shoal water—80 furlongs, half-way, lat. 43 degs. 30 mins. N., long. 38 degs. 50 mins. W.—in the direct great circle tract between this country and the island of Bermuda make it certain that means may be found of dividing any future cable into comparatively short sections; and while I repudiate entirely the idea of anything like precipices at the bottom of the ocean, except in recently-disturbed volcanic regions, there can be no doubt that more careful consideration of the currents and winds which sweep through and over the ocean will enable us to predict (as I myself had the pleasure of doing in the case of the shoal of which I have spoken) the existence of such shoals at points. As regards the outer protection, which is in these cables, as hitherto made, a very large proportion of the whole, nothing can well be worse than the exposure of unprotected iron-wire to the certain decay from rust, which causes an item in one company's balance-sheet of £8,000 a-year for deterioration, I am of opinion that a species of vulcanized rubber coating will be found the best and cheapest protecting material. I now turn to a part of the question to which I have more especially devoted my attention during the past five or six years—the safe carrying and laying of the expensive and delicate telegraphic cable. A reel offers the most convenient and certain mode of handling a long wire or a long rope. But the enormous length which was here to be dealt with, the certainty that the weight must be enough to task the carrying of the largest known ships, led to the abandonment of the idea which did not fail, at first, to present itself—of putting the cable, when made, on a reel, which should be carried by a ship, and thence running it off into the ocean in the track of the carrying vessel. I have said little doubt, if any, existed as to the advisability of such a mode of treatment, but the carrying it into effect

seemed impossible. It was at this time that I was led to consider that, after all, a ship, in mechanics, is nothing but a floating structure designed for carrying a special cargo; and that, given any other form of cargo than that hitherto carried, another form of structure might not only be admissible, but necessary. My experience, under Sir E. Belcher, of deep-sea soundings, led to the observation that a very rapid and easy method of letting a deep-sea line run itself off is to be found by letting the reel itself afloat on the water; and many other small experiences of the behaviour of cylindrical floating bodies, either when towed or revolving, came in to assist me in arriving at the decision which I eventually adopted, which I now advocate, and for a long time past have believed to be best calculated to insure success. This consists in the employment of one or more cylindrical drums, built of sheet iron or wood, exactly as strongly put together as these materials now are in ships, with no more liability to leakage, but with the remarkable difference that here you have a ship or floating structure, which is all hermetically sealed against the influx of water from any other cause. On these drums or floating cylinders the whole cable to be laid is coiled, and owing to the great capacity or cubical contents of any cylindrical body, as much cable can be well and safely carried in this way for £5,000 as would cost, if in a ship, £30,000, or six times as much (without the safety). I might say more, for the cable which is now to be carrried by the Great Eastern could be well carried on two cylinders costing less than £8,000 each. The plan has received the approbation of many of the most scientific and distinguished members of the profession to which I have the honour to belong, and I am happy to believe that it is gaining ground with the telegraphic engineers as well. To this system it has been objected, first, that the cylinder would need to be of great size; I answer that the necessary calculations have been closely made, and that so far from this being the case, the cylinders to carry an Atlantic cable need not be longer than an ordinary canal barge, or about sixty feet, and ten feet less in diameter. That it might leak: this has been provided for by making the cylinder pump itself out, and is less likely to occur in a cylinder than any other form of naval structure. Then, that it would require extraordinary power to tow it. I have carefully experimented in this direction, and I am sure that there is no reason to fear that any speed likely to be wanted cannot be obtained. Then, landsmen have said that it would, no doubt, be economical, but how could it be managed at sea? I think it may fairly be observed that, on this head, if naval officers are satisfied, that ought to be sufficient guarantee; but I have taken some pains to disabuse those who ask these questions, not on the difficulties of their own profession, but upon those of ours. Neither my brother officers nor I would compromise our reputations by advocating a vessel that would not on the ocean do that for which we designed it; and if any of these gentlemen were told by mere seamen that they had doubts as to the arcana of engineering or electricity, I fear their patience and good nature would not prevent their indulging in a severe criticism on the presumptuous ignorance of sailors. Independently of its advantages at sea, the reel system offers so many in the preliminary treatment of a cable, and so completely protects it from the wilful or accidental damage which has sometimes been fatal, that on these grounds alone it would be worth while to build them. I am making, and shall continue to make, exertions to get one constructed; but thousands would have been saved already, if, even for a storing cable as soon as made, this plan had been put in operation. If coiling back and forth be, as almost everyone allows, the worst treatment for a conducting wire, how much might have been avoided in the present Atlantic, which is first coiled in the gutta-percha works, then in the wire covering, then into tanks on shore, then into small ships, and finally in the Great Eastern's hold, where alone iron tanks, costing as much as any cylinders could do, have to be constructed for the purpose of keeping the cable in water during the laying? Surely this is a roundabout method of doing the right thing the wrong way. Besides, after this comes the brake machinery, and cones in the coil; all to accomplish—if, indeed, it be possible—by expensive and complicated machinery, that which can be done much better by the very structure which carries the cable. This, too, in the event of a gale occurring, leaves the vessel free to separate from the cable, and watch it, or act as may be required; or if, as in the first laying of the Otranto and Avlona cable, the length should prove insufficient, the vessel may go and seek aid, or may trust to the cylinder as a buoy, relieving the cable from her own weight until assistance can arrive. I rejoice to hear that Mr. Henley has been able to pick up the end of that cable; but had he had a cylinder to lay it with, supposing that by the effects of a current he had run short of cable, he would have had nothing to do but turn round, and, towing in the opposite direction, reel up the cable, and commence *de novo*. Upwards of 10,000 miles of telegraph cables have been made and laid, and of this not one single cable, that has any title to the name of deep sea, exists which has not been repaired, while most of those which come under this denomination have ceased to exist as means of communication. The majority of cables, which are talked of and written about as successes of eminent contractors, are either massive iron, which structures it was impossible to break, or they have been broken and raised for repairs; but all are undergoing a certain, and far from slow, process of decay, which need never have been allowed had the conditions of durability been apprehended and fulfilled as they might have been. But we ought not from these facts to argue that deep-sea cables are necessary failures, or that any difficulty exists in making and laying them, which cannot be met, or will not be overcome, when public competition takes the sting from the "moral" causes of failure, which have so often been trusted at as worse than the physical difficulties. At present, as an engineering friend remarked the other day, we are in the position of the hen who sits on the newly-contrived American nest with a trap-door in the bottom. The hen turns round disposed to cluck a triumph after the manner of such birds when the operation has been performed. But lo! there is no egg there! "I thought I'd laid an egg," quoth Dame Partlett. "I thought I'd laid a cable," says the telegraphic engineer.

Mr. Fairbairn also read a paper

ON THE MECHANICAL PROPERTIES OF THE ATLANTIC CABLE.

It appeared essential to the public interest that the second attempt to submerge a telegraphic cable across the Atlantic should not be left to chance; that a close and searching investigation should be entered upon; and that nothing should be left undone that could be accomplished to ensure success. For the satisfactory attainment of this object it was considered necessary—1st. To determine, by direct experiment, the mechanical properties of cables submitted for submergence in deep water. 2nd. To ascertain the chemical properties of the insulator, and the best means to be adopted for the preservation and duration of the cable; and 3rd. To determine the electrical properties and conditions of the cable when immersed, under pressure, at great depths. These varied conditions were left to a committee, on whom devolved the consideration of every question relating to the efficiency and ultimate security of the cable. That of its mechanical properties was left in my hands, and I was requested to undertake the first division of the inquiry, and to determine by actual experiment the strengths, combinations, forms, and conditions of every cable considered of suitable strength and proportion to cross the Atlantic. To fulfil these conditions and ensure correct results a laborious series of experiments were instituted, and, in order to attain accuracy as regards the resisting powers of each cable to a tensile strain, they were broken by dead weights, suspended from a crab or crane, by which they could be raised or lowered at pleasure. The weights were laid on one hundredweight at a time, and the elongations were carefully taken and recorded in the table as each alternate fourth hundredweight was placed on the scale until it was broken. By this process we were enabled to ascertain with great exactitude the amount of elongation in seven feet six inches.

From certain considerations it was deemed advisable to select a description of cable containing this element, and all the requirements to meet the contingent forces to which it might be subjected. With these impressions on the minds of the committee, it was found desirable to select that of Messrs. Glass, Elliot, & Co., which stands highest in the order of strength. In this inquiry upwards of forty specimens of cables have been tested in their finished state, and this might have been sufficient for the committee to determine the best description of cable; it was, however, deemed advisable to investigate still further, not only the cable as a cable, but to test experimentally each separate part, in order that every security should be afforded as to the strength and quality of the material to be employed in the construction. The whole of the specimens submitted by Messrs. Glass, Elliot, & Co. were composed of the same sizes of conducting wire, insulated within alternate layers of gutta-percha and Chatterton's compound, which formed the core of each. Surrounding this core were lapped, in a spiral direction, nine, and in some cases ten wires, of ·089 to ·098 inch diameter, and each wire was covered with Manilla yarn or St. Petersburg hemp, saturated with tar and other materials. Now, as these covering wires constituted the principal strength of the cable, it was found desirable to test them separately and in combination, for the purpose of ascertaining their tenacity, ductility, elasticity, &c. The wires were of three sorts—namely, steel and iron in its homogeneous or simple state of manufacture from coke, coal, and charcoal.

From a long series of well-conducted experiments it has been found that a good quality of ductile iron improves in strength by elongation—that is, the whole of its fibres are brought into action by the elongation of those first subjected to strain, or, in other words, they yield up only part of their strength until the force reaches the other parts, so as to produce uniformity of action throughout the whole section of the wire. This is a property of good iron which requires to be extended to the manufacture of both steel and homogeneous wire, and taking the experiments as they exist in the foregoing series of results, I find that with proper care in the selection of the material in the first instance, a judicious system of manipulation in the second, and a rigid system of inspection of the manufacture, that wire of homogeneous iron ·095 inch diameter can be made of strength sufficient to sustain from 900 lbs. to 1,000 lbs., with an elongation of ·0068, or $\frac{68}{10000}$th part of an inch per unit of length. This description of iron appears to be the most suitable for the Atlantic cable, as it combines strength with ductility, and may be produced at a comparatively moderate cost. Great care is, however, required to maintain, during the whole process of manufacture, the full standard adopted at starting, both as regards the strength and ductility of the wire. It was also found desirable to test the separate strands of each cable as well as the wires themselves. For this purpose a number of strands similar to those employed in the manufacture of the different cables were produced, and the tensile breaking strain and elongations carefully observed and recorded. In order to ascertain whether the length of the lay of the hemp and Manilla round the strand was of that spiral form which produced a maximum of strength, the yarn separated from the strand was also tested, and comparing the sum of the breaking strains of the wire and yarn separately, with that of the two in combination in the strand, the object by these means was approximately obtained. Another very important question arises in the construction of this cable,

and that is, the strength of the core and its conducting wire, and how it is to be protected under a pressure of 7,000 lbs. to 8,000 lbs. per square inch when lodged at the bottom of the ocean. This appeared a question well entitled to consideration, and provided a properly-insulated wire of one or more strands can, without any exterior covering, be deposited with safety at these great depths, it is obvious that the simpler the cable the better. Assuming, therefore, that gutta-percha is the most desirable material that can be employed as an insulator, it then resolves itself into the question, what additional covering and what additional strength is necessary to enable the engineer so to pay out of a ship a length of 2,600 miles into the deepest water as to deposit it, without strain, at the bottom of the ocean? This is the question the committee had to solve, and for this very important object experiments were instituted. Regarding the circumstances bearing directly upon the ultimate strength of the cable, we have arrived at the conclusion that the cable No. 46, composed of homogeneous wire, calculated to bear not less than from 850 lbs. to 1,000 lbs. per wire, with a stretch of five-tenths of an inch in 50 inches, is the most suitable for the Atlantic cable. The following is the specification of No. 46 cable:—The conductor consists of a copper strand of seven wires (six laid round one), each wire gauging ·048 (or No. 18 of the Birmingham wire-gauge), the entire strand gauging ·144 inch (or No. 10 Birmingham gauge), and weighing 300 lbs. per nautical mile, embedded for solidity in the composition known as "Chatterton's compound." The insulator consists of gutta-percha, four layers of which are laid on alternately with four thin layers of Chatterton's compound, making a diameter of the core of ·464 inch, and a circumference of 1·392 inch. The weight of the entire insulator is 400 lbs. per nautical mile.

The External Protection.—This is in two parts. First, the core is surrounded with a padding of soft jute yarn, saturated with a preservative mixture. Next to this padding is the protective covering, which consists of ten solid wires of the gauge ·095 inch, drawn from homogeneous iron, each wire surrounded separately with five strands of Manilla yarn, saturated with a preservative compound; the whole of the ten strands thus formed of the hemp and iron being laid spirally round the padded core. The weight of this cable in air is 34 cwt. per nautical mile—the weight in water is 14 cwt. per nautical mile. The breaking strain is 7 tons 15 cwt., or equal to eleven times its weight per nautical mile in water—that is to say, if suspended perpendicularly it would bear its own weight in eleven miles depth of water. The deepest water to be encountered between Ireland and Newfoundland is about 2,400 fathoms, and one mile being equal to 1,014 fathoms; therefore, $1,014 \times 11 = 11,154 - 2,400 = 4·64$: the cable having thus a strength equal to 4·64 times its own vertical weight in the deepest water. Breaking strain, 7 tons 13 cwt. In this report we have not entered upon the process of immersion, either in tanks or the sea; we have confined our attention exclusively to the cable and the quality of the materials of which it should be composed, and the questions of coiling, shipping, submersion, &c., we have left for future inquiry.

After a few remarks from Captain Galton,

Mr. Webster said there were three points to be considered—namely, the insulation, the structure of the cable, and the mode of laying it down. With regard to the former, he thought it was a pity the covering recommended by Captain Selwyn had not been tried. It might be paid out from a hole in the bottom of the ship, and he thought the first plan, recommended by Captain Selwyn, for the construction of the cable, was a good one.

Captain Selwyn, in answer to several questions, said the cylinder he proposed was 120 feet long by 90 feet diameter, and it would carry 22,000 tons, whereas the whole weight of the present Atlantic cable was only about 6,000 tons.

A discussion ensued on the foregoing papers, in which Mr. Fairbairn, Mr. Scott Russell, and other gentlemen took part, having more immediate reference to the length of the waves of the Atlantic, and in which a general approval of Captain Selwyn's suggestions was expressed.

ANNUAL REPORT BY CHAS. TODD, Esq., SUPERINTENDENT OF TELEGRAPHS, &c., SOUTH AUSTRALIA, 1863.

(*Continued from page* 142.)

The question, however, in which the public is mainly interested, is whether persons using the telegraph should not be indemnified against loss arising from mistakes made by the operators. By clause 7 of our printed regulations, the liability of the Government is limited to £5, and that only where a message is repeated at the additional cost of 50 per cent., and the same regulation is generally adopted throughout the world; but, as I mentioned in my report for 1861, a system of insured messages has been adopted on some of the English and American lines; but on the former it is very seldom availed of by the public, and each company only holds itself responsible for delays or errors on its own lines.

The Electric and International Telegraph Company insure repeated messages (on which the 50 per cent. additional charge is paid) at the following rates:—

	£	s.	d.		£	s.	d.
For any sum up to £100	1	0	0	Above £500 to £600	6	0	0
Above £100 to £200	2	0	0	" 600 to 700	7	0	0
" 200 to 300	3	0	0	" 700 to 800	8	0	0
" 300 to 400	4	0	0	" 800 to 900	9	0	0
" 400 to 500	5	0	0	" 900 to 1,000	10	0	0

And twenty shillings for every £100, or fraction of £100, above that sum.

The company will not be responsible for any amount beyond the sum for which the message is insured and the rates paid; nor do they hold themselves liable in any case for *delays* arising from *interruptions* in the working of their telegraphs.

I think we might safely adopt a similar system on the Australian lines, although I believe it would be seldom used; but I would prefer a reduced charge—say 25 per cent. instead of 50—for repeating. Persons would then more frequently pay for having important messages repeated, and if they adopted the additional precaution of giving quotations and numbers, somewhat in the way I have suggested, I am persuaded that very few serious errors would occur.

On the Indian lines, prior to May, 1859, all private messages had to be repeated at half-price extra. Since that date it has been optional, and the repeated messages comprise about one-fifth of the whole number.

I find from a recent report of Sir W. O'S. Brooke, F.R.S., Superintendent of Telegraphs in India, that—"In an analysis of 22,657 messages transmitted at repetition price in 1858-59, it was found that 492 messages contained errors, being a proportion of one in 46 messages. The 22,657 messages contained 525,617 words, of which there were 689 erroneous, being a proportion of one error in 762 words. In 1859-60, I have ascertained that in 105,893 messages sent in Bengal, Bombay, Madras, the East Coast, Ceylon, Scinde, and the North-Western Provinces, 1,605 contained errors, being one message erroneous in every 65. The 105,893 messages contained 2,342,812 words, of which 1,982 were erroneous, being one word erroneous in 1,182."

He further adds—"The true wonder is that so few mistakes occur. The sufferer by such blunders generally appeals to the press, and cites his case as a specimen of the general working of the department. The conclusion is not just. Nothing is heard or known of the 1,182 words which have been sent correctly, while loud indignation is naturally expressed for the one error in that number."

The best operators on the Indian lines are brought from England on a three years' engagement. Before appointment each candidate is required to pass a competitive examination, and must be not less than eighteen nor more than twenty-four years of age; and must either have passed two years in the service of a telegraph company, or as an articled pupil of a telegraph engineer, or must have given special attention to chemistry and physics at some school or college recognised by the Secretary of State. The salaries commence at sums varying from £15 to £30 a month. The Morse system is generally adopted in India, but in most of the offices Sir W. O'S. Brooke has recently dispensed with the registering part of the instrument—the operators reading by sound. This he considers has enabled him to effect a large saving. Here most of our Morse operators read by sound, but I prefer retaining the register on the tape, as in case of error it enables me to ascertain whether the transmitters or receivers made it. On the whole, I believe that fewer errors occur with the Morse than with the needle system. The former is used on all our main lines; but Henley's magnetic single-needle telegraph is used for railway service and for branch offices.

I regret to find that the railway telegraph service is very inefficiently performed under the existing arrangement. Except at Adelaide and Gawler (where junior operators are employed), the instruments are worked by the railway station-masters, who each receive £30 per annum for their services as operators. This is, no doubt, an economical arrangement, but it unfortunately happens that, when most required, the telegraph is often unavailable through the absence of the officer on railway duties. And from this cause messages, both on private and railway service, are often subject to such serious detention as to render them in many cases wholly useless. The only remedy for this would be to employ junior operators at each station in addition to the station-master, who could still work the instrument in the absence of the former.

EXTENSIONS PROPOSED.

Provision has been made in New South Wales for a line from Deniliquin, viâ the Murray, to the South Australian frontier, but its erection is still in abeyance, awaiting the decision of the two Governments as to the proportions in which the receipts should be divided. Until this vexed question is settled, I fear nothing will be done towards the carrying out of a work so urgently required to perfect our system of intercolonial communication.

I am of opinion that the claim of New South Wales for two-thirds of the receipts is unreasonable, and that one-half would amply repay her for the outlay, as it would not only secure uninterrupted and more rapid communication with this colony, with which she has an increasing trade, but also satisfy the just demands of her own subjects for telegraphic communication with Wentworth. To ourselves also, as I have not failed to urge, the construction of this line is of considerable importance; it would assist our trade with the Darling, and New South Wales generally, and also afford another means of communicating with Victoria by way of Echuca, in the event of an interruption on the present intercolonial line, which more than any other is affected by atmospheric disturbances, owing to its proximity to the coast for a distance of 165 miles—between Port Elliot and Guichen Bay—where it is exposed to the full force of the gales and vapours from the Southern Ocean, which more or less affect the working of the line, even in fine weather when the wind is blowing from the sea, and frequently renders it impossible to work the two wires at the same time.

A similar difficulty was felt on the Victorian line, between Warnambool and Portland, and in erecting the second wire, provision was made for a cross line from Hexham to Hamilton, thus establishing an inland communi-

cation between Melbourne and Portland; and should it be decided not to carry out the direct Sydney line, I would recommend the construction of a line from Wellington to Border Town, to be met at the boundary by an extension from Ararat or Hamilton, and a short line from Border Town to Kincraig, which would give an independent means of communication with Mount Gambier and the other south-eastern stations. Were this done, we should very rarely have any interruption. Sydney has now a choice of three routes for communicating with Melbourne—first, viâ Albury; second, by a line branching from the first at Gundagai, viâ Wagga Wagga to Deniliquin, and joining the Victorian system at Echuca; and third, by way of Bathurst and Orange to Wagga Wagga, where it meets the second wire, thus affording ample security from all stoppages.

A line from Wellington to Border Town and Kincraig would cost about £9,000. The direct Sydney line would cost about the same, or rather more, if a separate wire were carried from Gawler Town to branch offices at Tanunda, Angaston, and Truro. It has been strongly represented to me that telegraphic facilities are much required in the districts just mentioned, where at present the agriculturists are placed at a great disadvantage as compared with those in other parts of the colony.

The following table shows the amount of business transacted last year with each of the other colonies, from which it will be seen that the business with New South Wales has increased from £2,176 0s. 9d. in 1861 to £2,833 0s. 6d. in 1863.

Table showing the Receipts on the Intercolonial Messages between South Australia and each of the other Colonies—Victoria, New South Wales, and Queensland.

Month.	Receipts on Messages between South Australia and Victoria.			Receipts on Messages between South Australia and New South Wales.			Receipts on Messages between South Australia and Queensland.		
	Paid in South Australia.	Paid in Victoria.	Total.	Paid in South Australia.	Paid in New South Wales.	Total.	Paid in South Australia.	Paid in Queensland.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
January	248 11 8	277 9 6	526 0 9	153 13 0	203 2 0	356 15 0	15 0 0	15 0 8	30 0 8
February	185 2 4	205 19 1	391 1 5	83 5 6	125 18 9	209 4 3	9 6 8	4 16 8	14 3 4
March	239 5 11	249 17 4	489 3 3	103 19 0	147 5 9	251 4 9	7 18 0	8 18 0	16 16 0
April	205 17 2	225 4 2	431 1 4	87 10 0	124 13 0	212 3 0	5 4 8	4 6 0	9 10 8
May	230 13 4	187 10 6	418 3 10	84 19 6	80 10 3	165 9 9	5 5 4	6 4 0	11 9 4
June	249 2 2	281 18 11	531 1 1	85 13 0	159 14 9	245 7 9	7 9 4	4 19 4	12 8 8
July	160 19 10	171 8 5	332 8 3	74 19 0	161 7 8	236 6 8	10 8 8	3 19 4	14 8 0
August	210 5 5	199 5 2	409 10 7	108 12 0	165 17 9	274 9 9	12 14 8	8 1 4	20 16 0
September	178 15 0	145 15 9	324 10 9	57 8 9	87 18 3	145 7 0	8 2 0	9 4 0	17 6 0
October	230 4 0	219 1 10	449 5 10	98 14 6	134 0 9	227 15 3	9 8 8	5 18 0	15 6 8
November	199 7 10	180 0 10	379 8 8	81 8 0	125 11 6	206 19 6	7 18 0	7 16 8	15 14 8
December	170 16 5	232 18 7	403 15 0	121 16 6	180 1 9	301 18 3	4 9 4	5 17 4	10 6 8
Total	2,509 0 8	2,576 10 1	5,085 10 9	1,136 18 9	1,696 1 9	2,833 0 6	103 5 4	85 1 4	188 6 8

I regret that no provision has yet been made for extending our northern lines to Mount Remarkable and Port Augusta. The claims of the settlers have indeed been acknowledged, but objection being raised in Parliament to the proposal to carry out the work by means of a loan, it has remained in abevance.

(To be continued.)

CORRESPONDENCE.

THE HYDRO-ELECTRIC MACHINE.

To the Editor of the Telegraphic Journal.

Sir,—Will you, or some of your scientific readers, afford me some information as to the best form and size for a hydro-electric machine, suitable for a lecture-room. I should like the boiler and fittings, if possible, to be of such a weight that they could be moved and placed in position by two men, yet that the machine should be pretty powerful, and capable of working safely for three hours. I should also esteem full particulars respecting the best form of opening for the escape of the steam and production of the friction. Yours faithfully,

Merthyr, 15th September, 1864. W. H. Harrison.

To the Editor of the Telegraphic Journal.

Universal Private Telegraph Company, 4, Adelaide-street, West Strand, September 17th, 1864.

Sir,—In the leading article of this day's number of the *Telegraphic Journal* we find a statement that "the important position which this Company has attained is to be attributed mainly to the indefatigable exertions of the officers."

We have read this paragraph with much regret and annoyance, because we hold that inordinate encomium amounts to censure in disguise, and also because we observed with very great pleasure, at the last general meeting of shareholders, that the invaluable services of the directors were in some degree appreciated. You will oblige us by inserting this note in your next number.—We are, sir, your obedient servants,

Lewis C. Hertslet, Secretary.
Nat. J. Holmes, Engineer.

[We cannot perceive anything like an "inordinate encomium," or its equivalent, in the sentence above-quoted, which will be found to be similar to the remarks of the chairman at the last meeting of shareholders. A very nice distinction is indicated and sought to be established between the "officers" and the "directors." We hold that the directors are the *honorary*, as our correspondents are the *salaried* officers of the Universal Private Telegraph Company, and to the combined exertions of the unpaid and paid officers did we attribute the flourishing condition of the undertaking. If any other construction is placed upon our observations, it can only be by a perversion of their obvious tenour. We cannot commiserate our correspondents, as their "regret and annoyance" has been occasioned solely by their appropriation of the whole of a compliment, which was paid equally to their directors as to themselves.—Ed. *T. J.*]

AGGRAVATING FINES.

To the Editor of the Telegraphic Journal.

Sir,—As one who has experienced the annoyance of the *fining system* in telegraphy, and its utter failure to promote accuracy of transmission, permit me to suggest to the Directors, &c., the substitution in lieu thereof of a *system of rewards*, which is more in accordance with the practice followed in all other large establishments. Let those who have committed the lesser number of mistakes in the course of a year be liberally rewarded, and I venture to say that mistakes will be less frequent. Nemo.

TELEGRAPHIC NEWS.

Otrante and Avlona Cable.—This important line of telegraphic communication is now open to the public.

The Telegraph in India.—The *Times of India* announces that the telegraph line is completed between Deesa and Erinpoora, and in a forward state between Ajmere and Sojut. This portion will be completed in a few weeks.

Proposed Telegraphic Congress.—It is said that a telegraphic congress will be held in Paris on the 15th November, whereat proposals will be made for a uniform tariff, and for a reduction of charges for despatches throughout the empire.

Telegraphic Messages.—A reduction has been made in the cost of telegrams in Paris. A message can now be sent to any part of the city for fifty centimes, and the administration guarantees its delivery within half-an-hour from the time it is dispatched.

New South Wales.—The telegraph in this colony is in a declining condition. From a comparative statement of the consolidated revenue and of the special funds paid into the Treasury, at Sydney, during the quarters ending 31st March, 1863 and 1864, it appears that the receipts from the electric telegraph have decreased £1,552, or 17 per cent.

The Persian Gulf Telegraph.—It has been ascertained that the mishap to the Persian Gulf submarine cable, between Cape Monse and Gwadur, has been followed by the parting of the wire between the latter place and Mussendom. The Amberwitch, having on board a repairing staff, is on the spot, and, so soon as the weather will admit, active operations will be commenced for the restoration of this cable. It is reported that the land lines are not in a satisfactory working condition.

The New Atlantic Cable.—Active operations have been commenced during the week for the manufacture of the Atlantic telegraph cable. The construction of the core, with all the latest practicable improvements, is progressing at the works of the late Gutta-Percha Company, in the Wharf-

road, City-road, in accordance with the designs of the scientific commission. The iron wire and hempen covering, forming the exterior covering of the cable, are also in hand at the manufactory of the Telegraph Construction Company's works, under the direction of Messrs. Glass & Elliot, the contractors, at Morden Wharf, East Greenwich, a large number of artizans being employed at each of the above places for the purpose.

MISCELLANEA.

New Process of Hardening Timber.—A native of Russia has discovered a process by which timber, though newly felled, may become so hard as to resist the influences of the most trying climate for an almost indefinite period. The most curious part of the invention is that it does not involve the use of chemicals of any sort, such as steeping in creosote, &c., and that the process is applied to the tree while growing. The inventor is now making arrangements for the supply of his timber to railway contractors in England, and will not require any remuneration further than the amount which would be paid for ordinary timber, until the period shall have elapsed beyond which the ordinary railway sleepers and telegraph poles, &c., require to be replaced. The best railway sleepers require renewal at intervals of from four to six years, but the inventor of the new process asserts that he will supply an article which need not be disturbed for fifty years.

The Magnet.—A correspondent in *Notes and Queries* forwards the following interesting extract from "Pseudodoxia Epidemica, or Inquiries into Vulgar and Common Errors," concerning the magnet:—"But certainly false it is what is commonly affirmed and believed, that garlick doth hinder the attraction of the loadstone; which is, notwithstanding, delivered by grave and worthy writers, by Pliny, Solinus, Ptolemy, Plutarch, Albertus Mathiolus, Rueus, Langius, and many more. An effect as strange as that of Homer's moly, and the garlick the gods bestowed upon Ulysses. But that it is evidently false many experiments declare; for an iron wire, heated red hot, and quenched in the juice of garlick, doth, notwithstanding, contract a verticity from the earth and attracteth the southerne point of the needle. If also the tooth of a loadstone be covered, or stuck in garlick, it will, notwithstanding, attract and animate any needles excited and fixed in garlick, until they begin to rust, doe yet retaine their attractive and polary respects."

Curious Facts about Water.—The extent to which water mingles with bodies apparently the most solid is very wonderful. The glittering opal, which beauty wears as an ornament, is only flint and water. Of every 1,200 tons of earth which a landholder has in his estate, 400 are water. The snow capped summits of Snowdon and Ben Nevis have many million tons of water in a solidified form. In every plaster-of-Paris statue which an Italian carries through our streets for sale, there is one pound of water to every four pounds of chalk. The air we breathe contains five grains of water to each cubic foot of its bulk. The potatoes and the turnips which are boiled for our dinner have in their raw state, the one 75 per cent., the other 90 per cent. of water. If a man weighing 10 stone was squeezed flat in a hydraulic press, 7½ stone of water would run out, and only 2½ of dry residue remain. A man is, chemically speaking, forty-five pounds of carbon and nitrogen diffused through five and a half pailfuls of water. In plants we find water thus mingling no less wonderfully. A sunflower evaporates one and a quarter pints of water a-day, and a cabbage about the same quantity. A wheat plant exhales in 172 days about 100,000 grains of water. An acre of growing wheat, on this calculation, draws and passes out about ten tons of water per day. The sap of plants is the medium through which that mass of fluid is conveyed. It forms a delicate pump, up which the watery particles run with the rapidity of a swift stream. By the action of the sap, various properties may be communicated to the growing plant. Timber in France is, for instance, dyed by various colours being mixed with water and poured over by the roots of the tree. Dahlias are also coloured by a similar process.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2250. W. Chubb and S. Fry, improvements in the means or method of effecting communication between passengers, guards, and engine-drivers of railway trains.

2254. A. Bertsch, improvements in lightning-conductors, for preventing atmospheric electricity damaging electric telegraph instruments.

2255. R. T. Hall, improvements in the means of communicating between passengers and guards in railway trains.

2256. M. L. J. Lavater, improvements in the manufacture of driving straps or belting and of tubes of vulcanized india-rubber, and also in the manufacture of the helical coils of wire commonly inserted in vulcanized india-rubber tubes, also in desulphurizing articles of vulcanized india-rubber.

2260. J. H. Simpson, improvements in printing by electricity for telegraphic and other purposes.

2280. J. Adams, improvements in the means of communicating or signalling between the different parts of railway trains.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2075. T. Wray and R. Robinson, improvements in apparatus to facilitate communication between passengers, guards, and engine-drivers, travelling by railway trains.

2147. J. H. Johnson, improvements in apparatus for sounding alarm or signal bells.—A communication.

2151. J. S. Guy, improvements in apparatus for enabling passengers travelling by railway trains to communicate with the guard and driver.

PATENT SEALED.

680. W. A. von Kanig, improvements in railway telegraphs and signals, and also in the permanent way and carriages for preventing railway accidents.

PATENTS WHICH HAVE BECOME VOID.

2234. M. Henry, improvements in apparatus for signalling on railways by means of electricity.

2341. B. Sharpe, improvements in electric telegraph cables, and in the apparatus used for paying out such cables.

NOTICE TO PROCEED.

1336. W. Clark, improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive driving power.—A communication.

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

1386. A. V. Newton, improvements in the construction of and mode of working telegraphic apparatus.—A communication to him from abroad by Giovanni Caselli, of Florence, in the kingdom of Italy.—25th September, 1861.

PRICES CURRENT OF INSULATING MATERIAL.

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TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
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Stock	Electric Telegraph . . .	100	102 to 106	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1 to ½ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 3½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to par	—

TO CORRESPONDENTS.

L. N.—As our correspondent has written in his own name, it is but fair that he should be in possession of yours, as the subject is one which interests him personally.

A Reader.—We have not yet been able to ascertain the cause of interruption to the working of the Persian Gulf telegraphic cable. It is believed that as soon as moderately fine weather sets in communication will be restored, as the steamer Amberwitch, with a competent staff and all the necessary implements on board, is at Kurrachee, according to the reports received by the last mail.

D. Parry.—We do not recommend the so-called *cheap electric bells* for domestic purposes, as they are liable to be continually out of order; besides, they are generally constructed by persons ignorant of electrical action.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—
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THE TELEGRAPHIC JOURNAL.

Vol. II. No. 40.—October 1, 1864.

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RAILWAY ACCIDENTS.

There is many a useful lesson to be learned from a careful consideration of the causes which have led to a railway accident. The public mind is usually so inflamed with the garbled and inflated accounts of the calamity in the public papers, that calm investigation at the period of the accident is impossible. The accounts we peruse in the metropolitan press are usually elongated reports from anxious penny-a-liners, whose chief object is to lengthen the report to its extreme limit. They are penned by those totally ignorant of railway management and railway details. The evidence of excited eye-witnesses is implicitly believed and carefully noted. Every railway official is condemned and the public mind prejudiced. This even extends to our courts of justice. The *ex parte* statements of flowery counsel, and the questionable taste of an usually impartial tribunal, rendered the trial of the driver of the train that produced the mischief at Egham a perfect farce. There was neither reason nor justice in the remarks that were made on that occasion, and the exoneration of the driver from responsibility has effected more serious danger to railway travelling than the efforts of a whole lifetime can repay. Judges and counsel may be very good lawyers, but they are no railway workers, and the one is just as much a profession as the other—*ne ultra suter crepidam.*

When, however, the details of an accident are forgotten, and when an unprejudiced account is given of the causes that produced, and the effects that resulted from, an accident, then we can arrive at an impartial view of the case. Every accident that occurs upon any railway in the United Kingdom is immediately reported to the Board of Trade. The Committee of the Privy Council of Trade at once instruct one of their inspectors—usually officers of the Royal Engineers, and men of great experience—to inquire into the details of the case. A very careful investigation is made on the spot into every particular, and an elaborate report presented to the Board, giving a true statement of the causes that led to the accident, of the effects it produced, and making suggestions to remedy the repetition of similar disasters. These reports are periodically printed, and presented to both Houses of Parliament, and can be purchased for a very small figure at the Parliamentary Paper-office. They are well worth reading. They contain, not only an accurate account of every railway accident, but they form an excellent commentary upon railway management. They keep railway managers *en courant* of new ideas and approved inventions; and though it may be impossible and impolitic to carry out all the suggestions emanating from these gentlemen, still much benefit must accrue from a careful consideration of their ideas. We have the reports for the year 1863 before us, and many a useful lesson will their perusal convey. We will open the report, and take the first case that presents itself.

An accident took place on the 11th of July, 1863, upon the Lancashire and Yorkshire Railway, near Sowerby-bridge Station. Two passenger trains came into violent collision, and fourteen persons were more or less seriously injured. Colonel Yolland was sent down to inquire into the matter, and we reprint the greater portion of his report:—

Immediately adjacent to Sowerby-bridge Station, and west of it, there is a tunnel of about three-quarters of a mile in length, and the station is protected in that direction by a distant signal worked through this tunnel, and as an additional security a signalman's hut is placed a short distance further west, with a semaphore signal close to it, and the signalman works another signal 1,190 yards distant from the hut towards Luddenden-foot Station. The signalman in this hut regulates his semaphore and distant signals by the indications of the distant signal which is worked from the Sowerby-bridge Station. The distant signal worked from the hut can be seen from Luddenden-foot Station, which is nearly one mile and three-quarters west of Sowerby-bridge Station, or about 850 yards before the signal is reached; and the semaphore signal at the hut can be seen by the driver of a train as he passes the distant signal, but it is not continuously seen owing to buildings and the nature of the ground, and a curve and cutting on the line; it is also seen at a distance of 600 yards, but is again lost sight of in the cutting. The line falls towards Sowerby-bridge Station on an easy gradient of 1 in 377.

It appears that on the afternoon of the 11th instant the 2 p.m. Manchester train, consisting of engine and tender and sixteen vehicles, including two break-vans, on passing Luddenden-foot Station found the distant signal worked from the hut on at danger, and the driver says that he shut off his steam, and whistled for the breaks, *but did not stop at the distant signal, which he should have done according to the regulations,* but slackened speed and stopped at the signalman's box at 3.34 p.m. Shortly afterwards an East Lancashire train, which left Accrington at 2.40 p.m., followed the Manchester train, passed the Luddenden-foot Station, where the all-right signal was exhibited, and found the distant signal worked from the hut on at danger against it. This train consisted of engine and tender and three carriages, two of them fitted with Newell's continuous breaks, and worked by one guard. The driver of this train admits that *this distant signal was on against him,* and says that it always is on against this particular train when the Manchester train is in front, and that he ran cautiously down until he got under the bridge, where he could see the rear of the Manchester train, and then he whistled for the breaks, and did all he could to stop, by causing the fireman to put on his break, but did not succeed in doing so before he had run into the Manchester train, at a speed which he estimates at four or five miles an hour, but which another witness thought was fourteen or fifteen.

He says he thinks he was running about thirty miles an hour as he passed Luddenden-foot Station. The signalman at Luddenden-foot Station stated that there was an interval of six minutes between the passage of the two trains at that place, and an entry to that effect is found in the train-book; *but it is admitted that the entry was not made until half-past four o'clock,* when *the collision was known to have taken place,* and it is certain that the times entered could not be absolutely correct, although they might show the interval of time between the two trains. Other witnesses state that the Manchester train had not stopped more than one or two minutes before the East Lancashire train arrived and ran into it. The two trains are timed to arrive at Sowerby-bridge Station at an interval of five minutes apart.

The book of rules of the Lancashire and Yorkshire Railway Company direct that the danger signal at a station is to be exhibited for five minutes after the passage of a train, and then the caution signal is to be exhibited for another five minutes; and drivers are directed to *stop* at an auxiliary or distant signal, and then to draw cautiously inside it. But it appears that at Luddenden-foot Station the first rule is not obeyed, as the station-master, in answer to a complaint made by the guard of this same train that he had been detained at this station, wrote an explanation to the superintendent of the district that the East Lancashire train had been detained because the Manchester train had only been gone a minute and a half; but that in future he would not detain the train, but tell the signalman to give a caution signal, and trust to his being stopped by the signalman at the hut. It does not appear that this letter was ever answered, and the signalman did not give any caution signal to the East Lancashire train, but exhibited an all-right signal.

The signals at the hut, and the distant signal worked from it, were put up for the better protection of Sowerby-bridge Station last March, and the driver of the East Lancashire train stated that he obeyed the rule, which directed the driver to stop at the distant signal, for about a week after it was put up; but when he found that the semaphore signal and the distant signal always worked together—which they were intended to do—he ceased to do so; *and the signalman at the hut allowed that he never knew a driver obey that order.*

The rules and regulations of the company are drawn up in order to secure the safety of the public travelling on railways, and to protect the railway company from the serious cost of collisions and accidents; but it is perfectly hopeless to expect that these objects can be secured if the discipline on the line is not maintained and the regulations upheld.

If there are a sufficient number of efficient inspectors employed on the line

these infractions of the rules cannot happen without their shutting their eyes and omitting to report them; but the fact is, that infringements of the regulations are considered of no importance, unless an accident occurs.

The collision was produced by wilful disobedience of the regulations of the company by the engine-driver of the East Lancashire train, and the only surprising circumstance is, not that a collision has occurred, but that with such a lax mode of working more frequent collisions do not occur.—I have, &c.,

W. Yolland,
Col. Royal Engineers.

The Secretary, Board of Trade, Whitehall.

The italics in the above extract are our own. It will be seen, in the first place, what an utter disregard of regulations and instructions was exhibited by the driver. The distant signal was on against him, and yet he drove past it. This is a sample of that recklessness and habitual carelessness which is the true cause of half of our railway accidents; and this is the class of men from whose shoulders the wise tribunal at Guildford would shift the responsibility of urging trains and carrying lives. This happy driver naïvely stated that he obeyed the rule for about a week, and then invariably neglected it. Yet is the executive not wholly blameless for allowing such laxity to exist in the carrying out of their rules, and Colonel Yolland's strictures will be fully endorsed by every thinking man.

Another lesson to be learned from this accident is the utter worthlessness of record-books, unless strictly maintained and periodically examined. It is extremely rare to find any reliable statement made of correct entries being found in these books during times of accident, and it is far more frequent to find them falsified. Indeed, it is questionable whether record-books are of any service, for they always offer a ready means for careless men to screen their neglect, and carry on their duties in a slovenly manner. The Government inspectors, however, invariably urge their employment, and few railway companies carry on their service without their aid.

The futility of working heavy traffic on the "time" system is equally evident; and we need not repeat our arguments upon this point, having so recently discussed the relative superiority of the "time" and "space" systems.

We would, in conclusion, point out the evident danger that arises from a multiplicity of signals. We have here three signals used to effect what could easily be done by one. The object was to extend the Sowerby-bridge distant signal to Luddenden-foot Station for the better protection of the line between the two stations and Sowerby-bridge itself. For this purpose three signals, habitually worked in unison, were employed. The drivers, finding that they were always alike, followed only one, and that, of course, the furthest and most dangerous. An electric signal, such as Preece's semaphore, placed at Luddenden-foot Station, and worked from Sowerby-bridge, would dispense with the use of the hut, the man, the semaphore, and the distant signal near that station. Considerable expense would be avoided, and improved efficiency result. Railway managers, rather than use electricity—which they will not comprehend—go on depending upon line signals and fallible human agency until their over-caution produces actual mischief. In the multiplicity of signals there is danger.

RESISTANCE OF VOLTAIC BATTERIES.

By Cherokee.

It is wonderful what extraordinary things one finds in print, even in scientific books, or, rather, pseudo-scientific books—things put down in such a grave and serious manner, that there is no doubt the person performing the trick thinks that he has done something, and his brethren-in-seeming take it for granted, and go on repeating it without exactly knowing why. There is an extraordinary book made by a Dr. Noad out of a collection of eleemosynary electric scraps. These he serves up in a thin sauce of his own as an omnium pudding. I certainly do admire his alms-basket for its collection of scraps; but the cooking and the sauce are to the last degree bad. So much for Dr. Noad's book and its inconsequential conclusions. I read it as a duty because it was presented to me; but what I mention it for is his explanation of the laws of the electro-motive force and resistance of batteries. First he quotes "Ohm's Law," which is, of course, a plum in his pudding; then he tacks on to it a general law drawn from it by Professor Wheatstone—such a general law!

The electro-motive force of a battery of n cells is represented by this formula—

$$f = \frac{n\,E}{\frac{n\,R\,D}{S}}$$

Where E is the specific electro-motive force of the elements used, R the specific resistance of fluids, D the distance of the plates or thickness of the fluids, and S their sectional area, f is the electro-motive force of the battery. He says this formula leads to the following general law (Wheatstone, *Phil. Trans.*, 1843):—

"1°. The electro-motive force of a voltaic circuit varies with the number of the elements, and the nature of the metals and liquids, which constitute each element, but is in no degree dependent on the dimensions of any of their parts.

"2°. The resistance of each element is directly proportional to the distance of the plates from each other in the liquid, and is also inversely proportional to the surface of the plates in contact with the liquids."

After making this quotation the Doctor leaves it without making any comment—as much as to say, "There, if you don't see the thing clearly now, there is no help for you!" My dear Doctor, we do see it clearly—quite through it, and also see that there is nothing in it. A general law you call that, do you, drawn from the above equation? yet the first part does not agree with the equation, and the second part is merely putting the fraction $\frac{R\,D}{S}$ into words, and that rather clumsily; but as a rule for guidance in any such matters it is a delusion. In 1° it is said that the electro-motive force has nothing to do with the size of the elements. I know that this is the gospel according to those who know a thing or two; but it is not according to this formula at any rate—

$$f = \frac{n\,E}{\frac{n\,R\,D}{S}};$$

for when S varies, I fancy f will vary also. If S be doubled then $\frac{n\,R\,D}{S}$ will be half what it was; consequently, f will be double what it was. This is according to the formula from which this so-called law is said to be drawn, but clearly is not. I fancy he had a confused something in his mind about quantity and intensity, and battery resistance and size of element, which could not easily be disentangled; and so to save trouble tacked it on to "Ohm's Law."

I have also seen it stated—and I think in this book, too—that a battery will do the most work when the external resistance is equal to the battery resistance. Now really I am sorry for it, but I must question that also. No doubt it may be true where the arrangement is adjusted to that end; but certainly it is not generally so, for by increasing R or D you diminish f; but f is the direct power to do work which is here diminished, and at the same time the work to be done increased.

Our Doctor seems to have been dreaming about something of this kind, from what he has put down on the page preceding the one from which I have just quoted. He says:—"By increasing the number of elements of a voltaic series we increase the tension, urging the electricity forward; but then at the same time we increase the amount of resistance offered by the liquid portion of the circuit; so that, provided in both cases the circuit be completed by a perfect conductor, as a stout copper wire, *we obtain precisely the same results in both cases*,

*the electro-motive forces and the resistances being increased by an equal amount,** for

$$\frac{E}{R} = \frac{nE}{nR}."$$

It is true that $\frac{E}{R} = \frac{nE}{nR}$; but surely he does not believe that the electro-motive force of one cell is equal to that of n cells; certainly it is possible to make it so, but it is not a general law. If it were so, then it would be absurd to use more than one cell in any battery.

But here is the Doctor's reason for using more than one cell in a battery:—"But it is very different when the circuit is closed by an *imperfect* conductor, for a resistance which might weaken to a considerable extent $\frac{E}{R}$ might not sensibly diminish $\frac{nE}{nR}$; and in accordance with this, we find that when resistances have to be overcome it is necessary to increase the number of elements in proportion to those resistances."

He says it is very different when the circuit is closed by an imperfect conductor. Now, I should like to know what makes it very different, or at all different. Is not the same resistance supposed to be opposed to both $\frac{E}{R}$ and $\frac{nE}{nR}$, whether the conductor be good or bad. The Doctor says it may diminish $\frac{E}{R}$, but it may not sensibly affect $\frac{nE}{nR}$; but he does not say how this difference is to be brought about. Let us see: let m be the resistance opposed to each, and the Doctor says the result will be $\frac{E}{R} - m < \frac{nE}{nR} - m$, but $\frac{E}{R} = \frac{nE}{nR}$ and $m = m$, and if equals be taken from equals, the remainders will be equal. But perhaps the Doctor had no little boy fresh from his Euclid to tell him that, so he gravely tells that, in accordance with this, a number of cells is used when we want to overcome resistance.

Did ever mortal man flounder about like that out of one absurdity into another? It would have been far better if the Doctor had stuck to his blue pill and black draught, than attempt to teach us the laws of electricity, which he does not appear to know much about himself. Certainly there is some truth mixed up with all this, as there is usually with that which is false and absurd. Ohm's law is certainly true; but it does not fit into the Doctor's explanations. Somehow, it will not mean what the Doctor wishes to make it. I suspect he was entirely bothered with his terms—positive fluid, negative fluid, tension, electro-motive force, intensity, quantity, cathode, anode, anion, catheon, composition of the two electricities, &c., enough to muddle anybody, and the Doctor deals in all these largely and a long list more. Why, it is an enormous labour in itself simply to repeat all these "tall" words.

In looking over different books on electricity to find a formula by which to calculate the internal resistance of a battery, I came upon these quotations, but did not find the formula either there or elsewhere in such nice form as our layers-down-of-the-law are used to put things; so I will just put down the following for discussion, by the extra learned. I do not propose to consider the resistance of the cell wherein the electricity is generated; but the resistance it experiences in a series, or battery, after it is generated; for it is clear that electricity must first be generated before it can experience resistance. It is not so much that we want to know the internal resistance of a cell, as what the effect will be of adding cell to cell in a series; therefore on this view of the matter there will be in a series of n cells a resistance of $n - 1$ cell to each cell in the series.

Let one cell give $a°$, and n cells $b°$, and let the resistance of one cell to the current be $x°$,

$$\text{Then } na - \frac{n}{2}(n-1)x = b$$

$$na - \frac{n^2 - n}{2}x = b$$

$$\frac{n^2 - n}{2}x = na - b$$

* Our italics.

$$\text{And } x = \frac{na - b}{\frac{n^2 - n}{2}} = 2\frac{(na - b)}{n^2 - n}$$

$$\text{Therefore the resistance of } n - 1 \text{ cell} = \frac{2(na - b)}{n^2 - n}n - 1 = \frac{2(na - b)}{n}$$

$$= 2a - \frac{2b}{n}$$

Now, taking this resistance from $n\,a$, we have

$$na - 2a + \frac{2b}{n} = b$$

$$(n-2)a = \frac{(n-2)b}{n}$$

$$na = b$$

So that $$-2a + \frac{2b}{n} = 0$$

That is to say, the resistance equals nothing—beats the Doctor that! Will some of your readers, "*who know about these things*," tell me where the error is?

COMMUNICATION BETWEEN GUARDS AND DRIVERS.

Nearly ten years ago there was the same sensation upon this subject as there has been during the last few months, owing to the lamentable accident at Egham. The result may also be said to be the same. Railway managers are not convinced that communication between passengers and guards is necessary. Indeed, our rolling stock is so constructed that such communication would be highly dangerous to the guards. To render such a communication practical, we must alter the whole of our rolling stock, and station-platforms. And who is the man who would recommend such an expensive undertaking for the sake of avoiding the minute number of accidents that have arisen from the absence of such a thing?

As one of the most practical schemes that were then suggested and tried, we commend the following to our readers, many of whom will recognise its author. It was found impracticable from the fact, that while the engine drivers' whistle was distinct and clear in the guards' van, the guards' whistle was comparatively inaudible on the engine, owing to the loud clamour of the train destroying the sound. It must be recollected also, that while the guard runs into the sound the driver runs out of it.

There are many simple and effective schemes in existence to effect this object, mechanical and physical. The difficulty does not lie in effecting the communication, but in convincing railway officials of its utility. Let them once say that such a plan is wanted, and give the guard access to the train, we could acquaint them with dozens of practical and economical schemes for the purpose; indeed, the patent list is inundated with them. We leave Mr. Brittan's plan to the judgment of our readers:—

"At a time when the public mind is so occupied as it is at present, on the subject of the importance of establishing a communication between the guard of a railway train and the driver of the engine, with your permission I will offer a few remarks on the subject, and then describe, as far as I am able, something which, I think, would obviate the difficulty.

"Without professing to understand one tenth part of the schemes ingenuously recommended for the above purpose, I know of none which does not involve the necessity of extra attention, to a greater or less extent; and while the plan I will lay before you is not free from the same objection, yet I think, upon examination, it will be found to approach nearer to a self-acting and efficient arrangement than anything I have hitherto seen or heard of.

"From my observations of the manner in which railway business is transacted, the small amount of time to spare at almost every station, and the liability of railway officials, in common with other people, to forgetfulness of even important duties, I feel satisfied that one of the most essential elements in the contrivance must be such a simplicity as to render it almost

unimportant whether the subject is thought of by the officials or not.

"I am satisfied that all arrangements of an electrical character are also liable to objections, on account of the liability to derangement, and the generally delicate character of the apparatus used, and to the difficulty, when changes take place among the carriages, of ensuring, on the re-union of the carriages, a perfect circuit.

"What I would propose for the purpose is this, as follows:—To the axle of the guards' brake let there be fixed a strong pinion, which will, of course, revolve as the train moves on; near this pinion will be a strong wheel, capable of being brought into gear by the guard instantaneously. On the axis to which this wheel is fixed is a crank, which works an air-pump, which air-pump fills a wind-chest, which wind-chest has a valve capable of being acted upon by a spring, or weight, so as to act as a safety-valve. By this means, I see no reason why an amount of power, equal to the task of blowing a whistle, or whistles, may not be obtained, capable of being heard by the engine-driver of the longest trains, and under the most unfavourable circumstances.

"Having once established the foregoing principle, the arrangement of codes, &c., would be very easy. The following has struck me as very safe and simple:—Let there be two whistles, of an octave difference in their tones, and then take the code as now used in our printing telegraph; let the upper notes represent our dot, and the lower notes our dashes. By the engine-driver listening and counting the number of each note, he will be able to be spoken with upon any subject, he giving "understand" or "repeat" by the whistles he has now in use on the engine. I am so satisfied of the practicability of such a plan, that I have no doubt that two telegraph clerks would be able to hold a conversation any distance, after having had half-an-hour's practice."

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

IX.

A.D. 1839.—Mr. T. Spencer, on May 8, 1839, gave notice to read a paper on the "Electrotype process" to the Liverpool Polytechnic Society: this paper was read September 12, 1839. The experiments resulting in this discovery were begun in September, 1837. The invention comprises the following points:—1st. "To engrave in relief on a plate of copper." The plate was etched by the ordinary etching process, and copper electro-deposited in the sunken lines, so as to stand out in relief. 2nd. "To deposit a solid voltaic plate, having the lines in relief." An electrotype cast is taken of an engraved plate; as the lines are sunken in the plate, they are in relief in the electro-cast. 3rd. "To procure fac-similes of medals, &c." According to one method, an electro-mould and electro-cast from that mould was taken; and according to another method, a leaden mould was taken by pressure, and an electro-cast from that mould. 4th. "To obtain a voltaic impression from a plaster or clay model." The object was rendered conducting by means of "bronze powder," or gold leaf, and an electro-cast taken. 5th. "To obtain any number of copies from an already-engraved copper plate." A copper-plate is engraved in the usual way, an impression of it is obtained in sheet lead by pressure, and an electro-cast taken from the lead. It is besides stated that iron castings may be preserved from the weather by an electro-coat of copper. The single-cell process is used. The subject was afterwards brought before the meeting of the British Association at Birmingham in 1839, and numerous specimens were exhibited, thus attracting the attention of the public to this application of electric force. (See *An Account of some Experiments made for the Purpose of ascertaining how far Voltaic Electricity may be usefully applied to the purpose of Working in Metal*, by Thomas Spencer, Liverpool, 1839; also *Mechanics' Magazine*, November 23, 1844, p. 367; also Bakewell's *Electric Science*, p. 176.)

A.D. 1839.—Mr. C. J. Jordan, on May 22, 1839, communicated the results of his electro-metallurgical experiments to the editor of the *Mechanics' Magazine*, and the letter appeared in that periodical on June 8, 1839. These experiments were begun in the commencement of the summer of 1838, and they were made "with a view of obtaining impressions from "engraved copper plates by the aid of galvanism." A single-cell arrangement was employed to obtain an electro-cast from an engraved copper plate. The application of electro-metallurgical processes to various useful purposes was also suggested. (See *Mechanics' Magazine*, June 8, 1839; also *Jordantype, otherwise called "Electrotype,"* by Henry Dircks, London, 1842; also *Contributions towards a History of Electro-metallurgy*, deposited in the Patent Office Library, January, 1859, by Henry Dircks.)

A.D. 1839.—Colonel Pasley, in 1839, proposed to the Admiralty to blow up the wreck of the Royal George, which had been submerged for sixty years at Spithead, by electro-blasting. Brass guns of sufficient value to pay for all Colonel Pasley's operations were recovered. (See Dodd's *Industrial Applications of Electricity*, pp. 14, 15.)

A.D. 1839.—Dr. Golding Bird, in 1839, noticed that the platinum plates of a voltameter, already polarized by connection with a galvanic battery, when connected with an amalgamated zinc plate immersed in the acidulated water, would evolve hydrogen in unequal volumes, one nearly twice as much as the other. (See *Philosophical Magazine*, 1839; also Dr. Golding Bird's *Natural Philosophy*, pp. 238, 239.)

A.D. 1840.—Professor Wheatstone, at the commencement of the year 1840, invented his "chronoscope," or instrument for measuring the duration of small intervals of time; this instrument has been applied to measure the velocity of projectiles. It is composed of a clock movement, set free at the moment of the ball's exit from the gun, and stopped when the ball reaches the target. For this purpose a wire in the galvanic circuit, at the gun's mouth, is broken at the instant the ball passes out of the gun; the circuit is completed when the ball reaches the target. The galvanic current acts on the clock movement by means of an electro-magnet. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 142-150; also De la Rive's *Treatise on Electricity*, Vol. III., p. 484.)

A.D. 1840.—Mr. Murray, in January, 1840, used plumbago to make non-conducting surfaces conducting, so as to enable metallic copper to be electro-deposited upon them. (See Smee's *Electro-metallurgy*, History, pp. 21, 22.)

A.D. 1840.—De la Rive, in 1840, made known the process of electro-gilding employed by him in 1828. Platinum and silver wires were electro-gilt "by employing them as negative electrodes in a solution of chloride of gold." (See De la Rive's *Treatise on Electricity*, Vol. III., p. 546.)

A.D. 1840.—Professor Jacobi, in 1840, used a modification of Daniell's constant galvanic battery, consisting of a lead or copper cylinder, with thin earthenware to separate the fluid elements; the zinc is in the centre. (See Gmelin's *Handbook of Chemistry*, Vol. I., p. 422.)

A.D. 1840.—Mr. William Armstrong, of Newcastle, in 1840, successfully experimented upon the electricity of effluent high-pressure steam; the result was the hydro-electric machine. Faraday proved that the electrical excitement is due to the friction of the particles of water against the sides of the jet whence the steam issues. (See Bakewell's *Electric Science*, p. 45.)

A.D. 1840.—Smee's galvanic battery was invented in 1840. In this single-fluid arrangement the elements are, platinized silver, dilute sulphuric acid, and amalgamated zinc. (See Smee's *Electro-metallurgy*, p. 18; also Gmelin's *Handbook of Chemistry*, p. 419.)

A.D. 1840.—Mason, in 1840, employed the battery process in electrotypy. (See *Proceedings of the Electrical Society*, April 1840, p. 203; also Walker's *Electrotype Manipulation*, part I., p. 22.)

A.D. 1840.—Mr. Andrew Crosse, in 1840, imitated constant and intermittent springs, by passing the current from a constant galvanic battery through moistened pipe-clay in a garden-pot placed in a basin full of water. (See Noad's *Manual of Electricity*, pp. 390-392.)

A.D. 1840.—M. De Ruolz, on December 19, 1840, took out a patent [in France?] for electro-gilding. He uses the following solutions:—The double chloride of gold and sodium dissolved in soda, chloride of gold dissolved in yellow ferrocyanide of potassium, sulphuret of gold dissolved in neutral sulphuret of potassium. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 549-551.)

A.D. 1841.—M. Abria, in 1841, proved that, in magnetizing a steel needle by an electro-dynamic helix, whatever be the length of the needle, provided it is not longer than the helix, its poles are always

placed at the two extremities of the part inserted, and that the portion which is outside the helix is not magnetized. He also investigated the influences that the length and diameter of the needles, and the length and diameter of the helix, exerted over the magnetic intensity, and found that the longer a needle or helix was in comparison to its diameter, the greater the magnetic intensity. (See De la Rive's *Treatise on Electricity*, Vol. I., pp. 287-289; also Vol. II., p. 889.)

A.D. 1841.—M. De Ruolz, in 1841, electro-deposited brass from the cyanides of zinc and copper dissolved together in a solution of cyanide of potassium. (See Gore's *Theory and Practice of Electro-deposition*, p. 62; also Walker's *Electrotype Manipulation*, last edition.)

A.D. 1841.—Professor Grove, in 1841, read a paper at a meeting of the London Electrical Society, in which he proposed to etch daguerreotypes by the voltaic current. The solution used consists of moderately dilute hydrochloric acid. (See *Practical Mechanic and Engineers' Magazine*, October, 1841, p. 34; also Smee's *Electro-metallurgy*, p. 336.)

A.D. 1841.—Mr. Alfred Smee, in 1841, published the results of his electro-metallurgical experiments, and enunciated the laws regulating the character of the metallic deposit. He electro-deposited the following metals from their solutions in the reguline form:—Platinum, gold, palladium, iridium, rhodium, silver, nickel, copper, zinc, cadmium, iron, lead, and antimony. Many applications of electro-metallurgy are set forth and suggested in the three editions of Smee's "Electro-metallurgy." (See Smee's *Elements of Electro-metallurgy*, 1st edition, 8vo., London, 1841; also the 2nd and 3rd editions of the same work.)

A.D. 1842.—Professor Morse, in 1842, gave it as his opinion that Europe and America might be connected by means of the electric telegraph. (See Whitehouse's pamphlet, *The Atlantic Telegraph*, pp. 3, 4.)

A.D. 1842.—Mr. J. P. Joule, in 1842, made some remarkable researches on the electric origin of the heat of combustion. (See *British Association Report*, 1842, p. 31.)

A.D. 1842.—Bunsen's double-fluid galvanic battery was invented in 1842. Its elements are, coke, nitric acid, dilute sulphuric acid, and amalgamated zinc; a hollow cylinder of coke is made to surround a rod of amalgamated zinc. Bonijol places a hollow cylinder of zinc round a solid cylinder of coke. (See Gmelin's *Handbook of Chemistry*, pp. 392 and 423; also De la Rive's *Treatise on Electricity*, Vol. I., pp. 45-47.)

A.D. 1842.—Grove's gas battery was invented in 1842. This arrangement consists of platinized platinum plates arranged in pairs, one plate of each pair being in contact with oxygen gas and acidulated water, the other in contact with hydrogen and the same acidulated water; the pairs are connected as in ordinary galvanic batteries, and the gases are absorbed during the action of the battery. (See De la Rive's *Treatise on Electricity*, Vol. II., pp. 723, 733.)

A.D. 1842.—MM. Masson and Bréguet, in 1842, constructed an electro-dynamic coil, with which they obtained a spark between the poles in vacuo without previous contact, the apparatus being in connection with a galvanic battery. (See Noad's *Manual of Electricity*, pp. 726, 727.)

A.D. 1842.—Mr. Robert Davidson, in September, 1842, tried his electro-magnetic locomotive upon the Edinburgh and Glasgow Railway. It consisted of horseshoe electro-magnets opposed radially to keepers fixed on the driving wheel shafts parallel to their axes. Mr. Davidson was engaged in the construction of electro-magnetic engines in 1837. (See *Practical Mechanic and Engineers' Magazine*, November, 1842, pp. 49-52.)

A.D. 1842.—Roberts' single-fluid galvanic battery, and the method of using it for blasting purposes, were made public in 1842. The battery consists of cast iron and amalgamated zinc plates placed interlacing in a frame; the exciting liquid is dilute sulphuric acid. The whole apparatus for blasting consists of the battery, conducting wires, cartridges, and galvanometer to test the cartridges; the conducting wires are insulated from one another, and twisted so as to form one rope; they terminate in the cartridge, and have fine steel "balance wire" stretched across their ends; their other terminations are connected to the battery poles. To use this apparatus the cartridge is placed in the centre of the charge of powder, and the battery connection made, when the steel wire becomes red hot, fires the cartridge, and explodes the charge of powder. (See *Practical Mechanic and Engineers' Magazine*, November, 1842, pp. 45-48.)

A.D. 1842.—M. Matteucci, in 1842, wrote upon the electric current proper to the frog, and determined the condition of its development and its course. (See *British and Foreign Medico-Chirurgical Review*, January, 1854, pp. 134-137.)

A.D. 1842.—Wöhler and Weber, in 1842, used a double-fluid galvanic battery, in which iron was the positive as well as the negative plate; the positive plate was immersed in dilute and sulphuric acid, the negative plate in strong nitric acid, and thus kept in a passive state. (See *Annalen de Chemie und Pharmacie*, Vol. XXXVIII, p. 307; also Gmelin's *Handbook of Chemistry*, Vol. I., p. 423.)

A.D. 1842.—Moser, in 1842, discovered that if two bodies are in contact, or very near together, they impress their image upon each other. Karsten succeeded, a short time after Moser's discovery, in producing similar figures under analagous circumstances, making use of frictional electricity. A glass plate, placed between a coin and metal plate, which respectively receives and conveys away the electric fluid, has the image of the coin. This image appears, in its most minute details, on being breathed upon. (See De la Rive's *Treatise on Electricity*, Vol. II., pp. 174-180.)

A.D. 1843.—Mr. Cubitt planned the destruction of the Round Down Cliff by electro-blasting. This event took place January 26, 1843. (See Noad's *Lectures on Electricity*, pp. 191-193.)

A.D. 1843.—M. Dubois Reymond, in January, 1843, announced the following law of animal electricity (the so-called "frog current"):—"When any point of the longitudinal section of a muscle is connected by a conductor with any point of the transverse section, an electric current is established, which is directed in the muscle from the transverse to the longitudinal section." (See *British and Foreign Medico-Chirurgical Review*, January, 1854, p. 137.)

A.D. 1843.—Mr. J. P. Joule made public his galvanometer in 1843. This instrument consists of a pivoted magnetic needle, which can be surrounded by coils respectively adapted to the measurement of the galvanic current under examination. (See *Practical Mechanic and Engineers' Magazine*, October, 1843, pp. 39, 40.)

A.D. 1843.—MM. Bréguet and Konstantinoff, in 1843, constructed a chronoscope depending on the same principle as that of Professor Wheatstone; a rotating cylinder with styles is, however, substituted for the clock movement. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 138, 139, and 150; also De la Rive's *Treatise on Electricity*, Vol. III., pp. 484, 485.)

A.D. 1843.—Professor Wheatstone, in 1843, proposed to register observations of meteorological instruments. The electric circuit is completed by the contact of mercury with a platinum wire placed in the tube of the instrument. In this way the meteorological condition of space may be observed by means of a balloon, or the instruments may be buried in the depths of the earth. The "thermometer telegraph" is said, in a Report addressed to the British Association, to act perfectly at the distance of many miles. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 128-132.)

A.D. 1843.—Mr. Nott, on August 17, 1843, read a description of his rheo-electric machine to the British Association. It consists of a plate of glass and a plate of resin; the rubbers to these plates being connected, "a complete circle is formed, as in the voltaic pile." (See *Practical Mechanic and Engineers' Magazine*, September, 1843, pp. 469, 470.)

A.D. 1843.—Mr. G. Little, in 1843, described an "electro-magnetic motion." A metallic ball is caused to move in a circular metallic railway by the alternate tipping of the sole plate; the rails are divided at opposite points of the circle, and caused to complete the electric circuit differently, according to the position of the ball on one or other semicircle; the tipping of the sole plate is caused by horseshoe electro-magnets alternately excited by the above-described means. (See *Practical Mechanic and Engineers' Magazine*, August, 1843, pp. 435, 436.)

A.D. 1844.—Baron Reichenbach, in 1844, investigated the action of electrical forces of all kinds upon "sensitives," and found that electrified bodies appeared to the "sensitives," in an absolutely dark room, to give forth luminous emanations. Other effects are described. (See Reichenbach's *Researches on Magnetism, Electricity, Heat, Light, Crystallization, and Chemical Attraction, in their relation to Vital Force*. Translated and edited by Dr. Gregory, London, 1846.)

A.D. 1844.—Mr. George Little, in 1844, described an "electro-locomotive." It consists of an axle on which T-shaped magnets are placed; fixed horseshoe electro-magnets act upon these, and, by means of a commutator, produce rotation of the axle. (See *Practical Mechanic and Engineers' Magazine*, May, 1844, p. 290.)

A.D. 1844.—M. Pouillet, about the year 1844, invented a chronoscope, having for its principle the deviation produced by a given battery upon a given galvanometer by various durations of completion of the galvanic circuit. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 132-138; also De la Rive's *Treatise on Electricity*, Vol. III., pp. 485-486.)

A.D. 1844.—Mr. John Dancer's electro-metallurgical experiments were not published till 1844, although they were made about the year 1838. Metallic copper was deposited on sheet copper with a letter D, cut from a printed bill, fastened on to it by varnish. An electro-cast of a stamp on a copper cylinder was also obtained. (See *Mechanics' Magazine*, February 3, 1844, pp. 76, 77.)

A.D. 1845.—Schoenbein, in 1845, wrote upon ozone at the request of the British Association. This odorous principle is produced during the action of the electrical machine, manifested in thunder-clouds, developed in the electrolysis of water, and appears always to attend electric polarization. (See *Report of the British Association* for the meeting in 1845, p. 91; also De la Rive's *Treatise on Electricity*, Vol. II., pp. 469-480.)

A.D. 1845.—M. Heider, in 1845, employed a platinum wire, heated by a voltaic battery, to cauterize the dental nerves. (See De la Rive's *Treatise on Electricity*, Vol. III., p. 687.)

A.D. 1845.—Professor William Thomson, in 1845, showed how the electric polarization is to be taken into account in the Leyden jar. (See *Encyclopædia Britannica*, 8th edition, art. Electricity, p. 534.)

A.D. 1845.—Mr. C. V. Walker, in 1845, by means of three Daniell's cells and a brass anode, electro-deposited brass from a strong solution of cyanide of potassium, which had been sequentially electrolysed with a copper and zinc anode. Alloys of gold and copper, or gold and silver, may be electro-deposited by similar means. (See *British Association Report* for the meeting in 1845, p. 30.)

TELEGRAPHY AT THE BRITISH ASSOCIATION.

By Amicus.

Every unprejudiced individual will, doubtless, admit that electrical science, and its attendant, submarine telegraphic science, cut but a sorry figure at the meeting of the British Association. It is somewhat remarkable, but the illustrious presidents of these gatherings have pretty well something to say on every department of science, except this. One will speculate on the probable exhaustion of our coal-fields some two or three centuries hence, in proportion as we are economical or otherwise. Another takes us back to such remote periods as to really stagger us with the hazy distance; pre-Adamite, we may, certainly, call them, but somewhat in the same sense that we should term Rameses the Second the predecessor of Queen Victoria, or the Antediluvians as antecedent to this present generation. To read the history of the formation of our world upon the rocks, and trace its gradual development through myriads of centuries; to speculate upon the antiquity of man; and to set staid orthodox people by the ears at the apparent upsetting of the Mosaic record of the creation, are doubtless noble employments for one's time and faculties. And certain it is that it furnishes not only many columns, but many volumes, for the curious, far more interesting to some people than mere dissection of human motives and character, and the vivid or sensational pourtrayals of the seething passions that boil in the bosoms of modern bipeds. Sir Charles Lyell gave us a spice of almost everything, and as Bath was supposed to be an uncommonly ancient place, salubrious withal, having five mineral springs, and so forth, and patronized in times past by the upper ten thousand pretty considerably, of course he went into the subject rather, and exploded a few notions anent its antiquity, much to the chagrin of some of the natives. But from Bath we went to the ends of the earth, and had a taste of geography, geology, ethnology, and all the rest, but not a word of anything respecting the advance of telegraphic science. Why, sirs, here is a science of more vital importance to mankind, and the British empire in particular, than all the ologies put together. It is assumed that the president will take us a tour through all the sciences in his opening address; it is, however, unreasonable to expect him to do so. But if this session, just brought to a close, had been called a meeting for the association of scientific speculations, with just a *leetle* bit of mechanical speculation thrown in by way of variety, it would have been more aptly termed. The president set the example, by as thorough a speculating address as ever delighted an audience of profundities, and it is but justice to say that the example thus set was well followed up.

To wit, what was there of advancement denoted in the three papers read touching electrical and telegraphic science? Literally nothing.

First came Captain Selwyn, with a paper on "Submarine Telegraphy," a manifest misnomer, however, since it was the old dish warmed up afresh, which has already done service at the Inventors' Institute, and elsewhere. Nothing new had the captain to relate, unless it be that Mr. John Macintosh is the happy individual who has discovered the palladium which is to settle the battle of the insulators, henceforth and for ever. With respect to his own invention, it cannot be called new now, seeing the gallant captain has been straining every nerve these two years past to get it adopted. It is a good idea, doubtless, but that is not the point; and seeing it is not adopted we must call it a new old thing. No disrespect, however, is intended; it ought to be tried like a good many more things whose existence is ignored. Captain Selwyn's ideas of what would constitute a good cable, in respect of mechanical construction, are somewhat novel, and he can only lay claim to any practical knowledge of the subject from what he conceives would meet the requirements of the case nautically. There are, however, two, if no more, sides to this question. Still the views advanced were only a new edition of the same put forth at the Society of Arts, and other places, some time ago, so that this part of his paper was but a recapitulation of *what ought to be*, and might very well have been dispensed with. The man who made the first cotton reel was a benefactor to his species, as much so, perhaps, as the immortal unknown who made the first road; indeed, if it should so turn out that a long deep-sea cable cannot be successfully laid except by means of a huge reel, it will become a matter of doubt whether the former were not the greater man of the two, and, in that case, we shall unquestionably award Captain Selwyn the full meed of praise, and may he grow corpulent in more substantial proceeds. He loves his progeny, as a good parent should. Take, therefore, Mr. Thomas Allan's conductor, Mr. John Macintosh's insulator, make them into a cable, on the heart of oak principle, carefully eschewing any external covering, whether for protection or destruction, then add Captain Selwyn's cylinder, or, rather, add the cable on to the cylinder, as Clark does his cotton, and you are all right. Here is your cable and means of submersion all as simple and straightforward as the first three letters we learn in our primers. Let this prospect rejoice your hearts, ye poor demented ones, who have paid so dearly, in experimental lessons, of "how not to do it." Rejoice in the existence of the above triumvirate, who, without a doubt, will put "a girdle round the earth in forty minutes." Is there nothing new here? Let us hasten to revoke the rash expression made above. It *is new;* there's no mistake about it; but how unfortunate it should be all speculative. There are those ingrate, blind bats and moles, that they are, who put no faith in Mr. Allan, nor in Mr. Macintosh, nor yet in Captain Selwyn. Alas that it should be so! And alas! and alas! for the splendid dreams of one who erst had detailed so clearly to Earl Derby, K.C.B., &c., and his colleagues, how the four continents of this planet, and all the isles of the main might, by his principle of telegraphy, be banded together in one glorious confederacy, by a network of electrical communication, producing order, happiness, and harmony, like the golden cords that hold countless suns and myriad spheres in their unerring course; a dream worthy to be realised. But the man is something more than a dreamer, and deserves better of his country.

Next comes Mr. Fairbairn, "On the Mechanical Properties of the Atlantic Cable," and this paper, although speculative in the highest degree, is about the greatest novelty extant. Here is a man, perhaps the greatest recognised authority on mechanics, who has written some of the most useful and popular books thereupon in the English or any other language, whose utterances are oracular, and who merits and receives, in mechanical affairs, the trust and confidence of the mechanical community, and whose practical abilities have earned for him a wide-spread fame, and a host of letters to the end of his name—yet here is a man tacitly delivering a laudatory address on the "mechanical properties" of a cable, the very construction of which sets at nought some of the plainest mechanical laws. Well, well, shall we use the hackneyed phrase and say, "truth is stranger than fiction!" Extremes meet, and many a wise man errs. No, no, it was quite right "not to leave the cable to chance;" and yet it looks very much as if "chance" or something not much better had had to do with it. We must necessarily infer that the jade had a pretty considerable hand in the first, but she must have set a tolerable copy, seeing the second

is so much like it, being, in fact, a second edition, enlarged, and (shall we say?) revised. Mr. Fairbairn, like Captain Selwyn, very carefully enters into the minutest descriptive details of the construction of a cable, with which the public are already sufficiently posted up, therefore there can be nothing new, and decidedly no advancement is denoted of telegraphic science, except *in prospectu*, and that is necessarily speculative, if not problematical, so far as this design is concerned. But its High Priest is far too sensible a man to be sanguinely prophetical of the result. He confines himself mainly to the, in his view, reasonable grounds there are for anticipation that it *will be* a success; it is to be feared, however, that these will be considered of little worth by most people. The novelty of this paper consists in certain assertions which one would have thought so careful a man would studiously avoid making. For instance, it was necessary, as it were, to make some remarks respecting the insulation, as a sort of half apology for the adoption of precisely the same description of dielectric used in its ill-fated predecessor; since some people (whether justly or not, it doth not behove us to inquire) attributed its failure, in a great measure, to the defectiveness of the material used as a coating for the conductor. In justifying, therefore, the joint use of gutta-percha and Chatterton's compound, it is asserted "that although caoutchouc is a more perfect insulator than gutta-percha, the latter is the more durable." With unthatched deference let us ask, how does Mr. Fairbairn know this? True it is rolled as a sweet morsel under the tongue of those who, naturally enough, wish to keep a formidable rival out of the field; but it is a cuckoo cry, nevertheless, and has not a tittle of foundation in fact; it is so much the more to be deplored, therefore, that this eminent mechanician, and practical philosopher, should allow himself to be made the echo of monopolists. This gentleman, however, seems to be in blissful ignorance of his inconsistency as a mechanic. "The covering wires (of iron) constitute the principal strength of the cable." Indeed! "The convolutions of a spiral never elongate." Oh! dear no! And consequently no strain can fall upon the only longitudinal portion, namely, the core and its frail conductor! Of course iron does not rust in water, and, if it did, how is it possible to supervene when carefully embedded in "Manilla yarn, saturated with a preservative compound!" The protector of a protector! Imagine Oliver Cromwell wanting his wife to take care of him! Captain Selwyn had spoken of the invention of Mr. John Macintosh as the *ne plus ultra* of perfect insulation, but strange to say this material is not only not adopted in the manufacture of the most important cable that will, in all probability, ever be required, but there is no allusion made to it, and the contest seems to have lain between gutta-percha and india-rubber, and the former gained it. So much for Mr. Fairbairn's contribution to the advancement of speculative mechanical science, with assumptions, contradictions, and inconsistencies, to the session of 1864.

The paper read by Mr. Thompson, "On the Mechanical Theory and Application of the Laws of Magnetic Induction of Electricity," is of a very different description. May the Fates keep us from getting out of depth here! What an absurd idea to suppose that the charge of a thunder-clap does not weigh so many ounces avoirdupois! Will anybody write to that marvellous man, the editor of *Notes and Queries*, and inquire the exact weight of the electricity used in telegraphing Her Majesty's Speech of last February to the Imperial Lord of the Tuilleries? But if electricity were a ponderable fluid it could not be induced, therefore don't trouble the erudite gentleman with any questions, the answer seems to be "nil," and the charge of the aforesaid cloud is force (in a form?). If "heat be internal excitation of motion in matter," and "light the excitation of motion in a rare medium called æther," since "they are not matter, but force in act," why, it necessarily follows that electricity and magnetism are not matter, but different developments or forms of force, "which may either be in conatus or in act." Hence "electric conduction is molecular movements of particular portions of matter, and "magnetic conduction is the symmetrical arrangement, into a vortical sphere of spirals, of a general medium, which pervades all matter and holds it in that form for the time being;" and of course we all know how these different forms of force are excited. Well, here was a new theory, at any rate, for the sages at the mineral springs to cogitate over, but, novel as it is, it seemed to drop almost still-born in their midst; there was no discussion, or next to none; and yet, doubtless, there were men present who had not given up the undulating theory of light, and a good many other old-fashioned theories, so esteemed by our author. But this theory was to lead to a practical result. Mr. Thompson is, if not an inventor, at least an ingenious adapter of something like an amplified Ruhmkorf coil, whereby five cells of Daniell are made to do the work of 100 cells of the same in an ordinary voltaic battery, a result, by the way, well worthy the consideration of all electricians and telegraph engineers, and is hereby specially recommended to the consideration of the magnates in Telegraph-street.

But the question arises, are the advantages gained by doing away with 95 per cent. of battery power with all the accumulated dirt, trouble, consumption of zinc, water by local action, and all the rest of the inconveniences consequent on a large series of elements, sufficient to compensate for the wear and tear of a series of connected induction coils, whose whole capacities are taxed to the utmost in order to make the five cells, as generators of the induced charge, equal to the 100 cells without the coils? In other words, is there any pecuniary gain? Competent judges say there is not. Ordinary induction coils only give a spark as the machine makes and breaks contact; but Mr. Thompson claims to produce a continuous stream of electricity by his arrangement, and that it is non-intermittent. If it be so, he certainly has accomplished something. But here again good judges are at issue with him, and declare absolute non-intermittence to be an impossibility. Certainly, if it be intermittent, the contrivance is comparatively useless for signalling purposes. But the great test of its use or worthlessness will depend upon its adaptability to the requirements of long lengths of submarine cable. A good authority, the late Dr. Esselbach, says that a spark even cannot be obtained where there is not perfect insulation; and perfectness of insulation is simply impossible in submarine lines, whether the dielectric be gutta-percha, india-rubber, or Mr. John Macintosh's preparation of paraffin. There is always a degree of induction to be overcome—an obstacle with which a charge of induced electricity by Mr. Thompson's contrivance would be simply unable to cope: at least, such is the general opinion. In order to establish the mechanical soundness of his arrangement or invention, Mr. Thompson began by the promulgation of a theory which overturns remorselessly the prevailing ideas of light and heat, and necessarily of electricity and magnetism also; but it is merely speculative, and far from being established; and even if it were, it is difficult to see how telegraphic or any other science is advanced or benefited by it. The electro-magnetic induction machine is a clever contrivance, but it remains to be seen if it really be worthy to supersede the ordinary mode of generating electricity for telegraph and other purposes. And if it should turn out to be all that he claims for it, the advantages even then are not such as to justify the author in claiming the having advanced electrical science to any appreciable degree. It was unfortunate for Mr. Thompson that he could not speak *ex cathedra*, for then all the smell-funguses of Germany would have been down on him on the light and heat theory, and he would have been a great man. Who would have cared about Colenso and the Pentateuch if he had not been a bishop?

THE EMBRAYAGE ELECTRIQUE.

At a recent meeting of the Association of Foremen Engineers, Mr. Gettliffe read a paper on "An Apparatus for the Prevention of Steam Boiler Explosions and Railway Accidents." That gentleman, after some preliminary observations, proceeded to say that the apparatus in question was the invention of M. Auguste Achard, C.E., of Paris, and that it was known in France under the title of the "Embrayage Electrique." It was calculated to maintain a constant level in steam boilers by automatic means, and without the assistance or supervision of the engine-man. This regulator, as it might be termed, consisted of a rachet wheel of peculiar construction, and which was keyed, upon a spindle turning freely in its bearings. Right and left of the wheel were mounted, loosely on the spindle, two wrought-iron levers of about twenty inches each in length, and connected together by cross-pieces. A two-armed "click," supported by the levers, turned freely round an axis. The double click acted freely upon the ratchet wheel, which was furnished with two sets of teeth, turned in opposite directions to each other, and separated by a blank space. The click was fitted with a tail-piece in the form of a fork, the two prongs of which were braced together by a cross-rod. In the fork was mounted an "armature," which was provided with an opening through which passed the cross-piece. The armature was made of brass, and to it was attached a plate of soft iron fitted in so as to be flush with the surface of the armature. Opposite to this latter was placed a horizontal electro-magnet, the poles of which abutted against the armature in such a way as that it (the armature) could only slide against the poles, without coming into immediate contact therewith. The part played by the armature was merely to act as a weight on the levers supporting the fork; for it would be understood that when the electric current was in circulation, the armature would be suspended by its adherence to the electro-magnet, and thus relieve the fork of its weight. The

suspension of the current, on the contrary, would cause it to drop on the cross-piece connecting the levers, and thus alter the gravity of the fork. It was these alternations of the weight on the tail-piece of the levers which caused the fork to act upon the upper or lower set of teeth on the ratchet-wheel; or, in other words, to open or shut the feed-cock of the boiler. It was necessary that the fork should have continual motion—a kind of pump-handle movement indeed—which could be effected by a simple contrivance (a small eccentric, for instance, attached to a running shaft on the general machinery). The effect would be that the compound rachet wheel would be acted upon and moved in one direction when the boiler required feeding, and in the other when it had been fed sufficiently. If all were going on well, the click would be simply moved over the blank portion of the wheel, and communicate no motion whatever to it. Proceeding now to the general action of the contrivance, the reader proceeded to state that when the current was broken off from the electro-magnet, the weight of the armature operating upon the cross-piece would press down the tail-piece of the levers carrying the click, which latter would rise and act with its lower arm upon the rachet wheel. The consequence would be, that the wheel would turn from left to right to the extent of one tooth, or about half-an-inch, at each oscillation of the levers, until the blank space presented itself and stopped further movement. This would be at a point when the wheel had made one-fourth of a revolution. On the other hand, when the current was in circulation, the armature, in sliding against the poles of the electro-magnet, would bring the plate of soft iron into contact with the poles, which would then hold it firmly, and prevent the armature descending with the click during the downward oscillation of the levers. The tail-piece would thus be relieved, and not have to support any weight while the levers rocked in the opposite direction. It would follow that the upper arm would then act upon the wheel, and cause it to turn the reverse way, *i.e.*, from right to left. It would thus become evident that the two-armed click would act on the rachet wheel, and cause it to move in opposite directions, whether the electric current were traversing the electro-magnet or not. "Now," said the reader, "the characteristic feature of the electric regulating apparatus is arrived at." The rising or falling of the float in the boilers of stationary or land engines controls the electric current, and causes it to circulate or be interrupted at the proper times. This result is obtained directly by the wires which proceed from the pile or battery being made to pass first to the float, instead of being connected immediately to the electro-magnet. The float itself was connected by a rod with an index, on the lever of which was mounted a piece of wood, faced on one side with a brass plate. On another piece of wood, in the form of a rocking lever, and moving on an axis, was a second plate of brass. The electric wire from one of the poles of the battery was fixed to the first-named plate, and the other end of the wire, after traversing the electro-magnet, was attached to the other pole of the battery. In order that the current might circulate, it was indispensable that both plates should meet, and, from the peculiar arrangement of the two metallic plates, they would always be in contact when the index was at zero (the normal feeding point) or above it, but the contact ceased as soon as the index fell below zero. Let it be supposed that the feed-cock of the force-pump, or other contrivance for supplying water to the boiler, was connected to the spindle of the ratchet wheel; it would follow that the cock must partake of the movement of the wheel, and that it will make a quarter of a turn in one direction when the electric current circulated, and a quarter of a turn in the other when the current was interrupted. Thus the automaton regulator, which was sensitive to the smallest alteration in the water level of the boiler, was perpetually and inevitably maintaining it at a constant height, and thus one great source of danger was obviated. As an extra security, however, against accident by explosion, a minor contrivance was affixed to the same apparatus, and which owed its action to similar principles. On the side of one of the levers was fastened a cap with a gudgeon in its centre. An armature resembling that already described was carried by this cap and rested on the gudgeon. In connection with the second armature was placed an electro-magnet, against which it was made to slide and press constantly upon the poles. It was still the index of the water gauge, which induced the circulation or effected the interruption of the electric current; and the same electric pile or battery, composed of a single element, or Daniell's pair, sufficed to put in motion the two electro-magnets. The electric wire which proceeded from one of the poles of the battery, and was affixed to the brass plate on the lever of the index, served for the two electro-magnets also. The returning wire, corresponding with that about to be described, however, was fixed to a third brass plate, and, after traversing the electro-magnet, was attached to the second pole of the battery. The last-mentioned plate was arranged in such a manner as to establish a metallic contact, which permitted the electric current to pass, notwithstanding the variation in the level of the water to the extent of an inch above or below its proper line. If the variation exceeded these limits, the current would be forcibly broken. When the electric current was in circulation—that is to say, when the lever was between the limits of variation named—the armature would be suspended by the adhesion of the second electro-magnet, but, if the level rose or fell beyond those points, the armature, from the current being broken, must fall. In either case, a small tappet fixed to the armature below the gudgeon touches an alarm lever and thus rings a bell. This arrangement was also serviceable in other respects. The alarm bell rings when the feed pump is out of order, when the electric pile ceases to act, if the stoker neglects the fire, or if steam is generated too rapidly. The reader proceeded to point out the application of the "Embrayage Electrique" to the prevention of railway accidents, by connecting it with brakes upon the wheels of the engines and carriages, and certainly gave some very practical illustrations of its value and efficacy in this respect. In France it is extensively used, and testimonials in its favour from many eminent scientific men were submitted to the Associated Foremen Engineers. Mr. Gettliffe, moreover, exhibited the apparatus itself to his audience, and thus gave them a further opportunity of judging of its characteristics.

ANNUAL REPORT BY CHAS. TODD, Esq., SUPERINTENDENT OF TELEGRAPHS, &c., SOUTH AUSTRALIA, 1863.

(*Continued from page* 155.)

RECEIPTS AND EXPENDITURE.

The number of messages, it will be seen, has increased from 76,725 in 1862 to 86,411 in 1863; and the net revenue from £7,677 5s. 8d. in the former year to £8,429 19s. 1d. in the latter. The total value of messages in each year was respectively £11,801 3s. 7d. and £13,120 16s. 7d., being an increase of £1,319 13s. 0d.

Compared with the previous year, the receipts show an increase at the following stations:—Adelaide, Port Adelaide, Peninsula, Gawler, Clare, Glenelg, Nairne, Woodside, Strathalbyn, Port Elliot, and M'Grath's Flat; and a decrease at Kapunda, Auburn, Burra, Mount Barker, Willunga, Goolwa, Guichen Bay, Mount Gambier, and Penola.

At Kapunda and Auburn, although the receipts were less than in 1862, the actual amount of business was more. The only serious falling off was at Guichen Bay, where the receipts fell from £318 19s. 0d. in 1862 to £211 2s. 9d. in 1863; and at Penola, where they declined from £200 11s. 9d. in 1862 to £149 12s. 3d. in 1863. The receipts at Mount Gambier have steadily decreased since 1861, owing to a portion of the business being transferred to M'Donnell Bay, and to the fewer land sales in the immediate district.

The total expenditure, exclusive of new lines, was £9,968 18s. 10d., of which £8,798 0s. 1d. was the proportion charged to working expenses and maintenance of lines, or, adding the rent of the chief office (£310), £9,108 0s. 1d., a sum exceeding the net revenue by £678 1s. 7d., a fact to be accounted for by the number of unremunerative country stations.

The expenditure for the maintenance and repairs of lines was unusually large owing to the heavy gales and long continued rains of the winter, which of course told severely upon every weak pole. For convenience in comparing the operations of the past with former years, I have given in the following table the revenue of each station during the last four years:—

Table showing Receipts at every Station during the Four Years 1860, 1861, 1862, 1863.

Station.	Total Receipts.											
	1860.			1861.			1862.			1863.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Adelaide	4,276	10	6	3,867	17	7	4,150	7	8	4,383	3	3
Adelaide Railway	104	9	0	95	14	3	90	8	0	83	4	0
Bowden	37	14	0	35	16	6	41	5	2	40	14	6
Alberton	25	2	0	25	18	6	26	4	8	28	2	3
Port Railway	45	11	0	44	9	3	44	18	9	46	4	8
Port Central	741	12	6	897	4	7	928	15	4	1,022	18	8
Peninsula	53	8	8	66	19	7	82	12	5	88	9	9
Dry Creek	—			20	0	0	25	0	0	25	0	0
Salisbury	46	7	0	35	17	10	44	15	4	42	14	6
Smithfield	33	17	6	27	16	9	33	9	10	32	17	0
Gawler Railway	34	4	9	27	7	6	37	9	10	36	10	6
Gawler Town	262	8	5	235	5	0	228	3	7	285	11	11
Roseworthy	—			10	13	10	28	12	6	29	4	0
Freeling	—			12	9	10	28	4	9	32	0	9
Kapunda Railway	—			10	8	4	25	0	0	25	0	0
Kapunda	178	9	9	145	9	9	159	13	0	146	8	5
Auburn	—			—			91	15	10	86	13	1
Kadina	—			—			122	18	10	282	18	9
Wallaroo	—			—			—			181	16	0
Clare	146	17	2	142	3	7	119	7	2	134	10	0
Burra	239	1	7	205	14	7	211	18	0	196	2	1
Glenelg	30	17	0	19	17	5	30	0	6	42	9	4
Mount Barker	35	6	3	71	6	5	37	5	10	35	6	2
Nairne	13	19	6	29	18	8	18	5	0	22	0	7
Woodside	13	19	6	18	19	6	23	3	1	27	3	5
Gumeracka	—			—			9	0	9	16	13	0
Strathalbyn	32	4	11	56	18	3	74	14	5	72	13	3
Willunga	42	15	8	56	16	6	71	11	2	66	8	0
Yankalilla	—			—			14	4	2	50	8	0
Port Elliot	77	18	5	88	17	11	112	4	4	158	19	7
Goolwa	110	17	8	96	0	3	92	10	0	78	10	11
Wellington	—			—			—			41	9	8
M'Grath's Flat	—			—			22	1	10	26	13	6
Guichen Bay	287	14	8	333	18	10	355	16	9	248	7	4
Mount Gambier	441	17	5	483	4	2	394	12	1	369	6	10
Penola	101	4	6	219	4	6	215	18	8	188	11	6
Kincraig	—			—			—			87	13	9
M'Donnell Bay	—			—			105	5	0	187	7	7
	7,414	9	4	7,382	9	8	8,047	7	7	8,695	0	1

Dividing the stations into two classes, paying and non-paying, the former comprises the following:—Adelaide, Port Adelaide, Gawler, Kapunda, Clare, Burra, Kadina, Wallaroo, Port Elliot, Robe, Mount Gambier, Penola, and M'Donnell Bay; and the latter—Peninsula, Auburn, Glenelg, Mount Barker, Nairne, Woodside, Gumeracka, Strathalbyn, Willunga, Goolwa, and M'Grath's Flat. The Yankalilla, Wellington, and Kincraig offices just about pay their expenses.

It is, however, too early to expect the telegraph to yield any profit; its real value, as I have before remarked, consists, not so much in the actual amount of revenue which it yields, but rather in the aid which it affords to commercial enterprise, the administration of justice, and the rapid settlement of the country through which it extends; regarded in this light, it far more than pays for the outlay incurred in its construction and maintenance.

CENTRAL OFFICE.

Pending the final decision of the Government as to the site for the central office, arrangements have been made with Messrs. Green & Wadham for an extended occupation of the present premises for another year, and I have made such alterations as will meet our immediate requirements. The whole of the lines are brought into one office at night, which enables me to economize my staff, and great improvements have also been made in the battery cellars.

LINES IN OTHER COLONIES.

For the following information relative to the progress of the telegraph in Victoria I am indebted to the valuable report of Mr. M'Gowan, detailing the operations of his department up to the end of 1862. His report for last year has not yet reached me.

In 1862 provision was made for the following works, the estimated cost of which was £34,250, viz.—Removal to, and erection of, lines along the routes of the railway between Geelong and Ballaarat, and between Melbourne and Sandhurst (including special provision of a distinct wire for railway service); a second (intercolonial) wire between Albury, New South Wales, and Mount Gambier, South Australia; a branch line from Ballaarat to Smythesdale; a line from Avoca to Red Bank; an extension of the Inglewood line to Swan Hill.

In 1863 provision was made for further extensions, viz.—1. A line connecting Melbourne with Sale and Port Albert (Gipps Land). 2. A branch line from Castlemaine to Newstead. 3. A branch line from Hexham to Mortlake. Besides alterations and improvements to existing lines, amounting to £7,500, making in all an estimated expenditure of £18,500.

The second intercolonial wire from Melbourne to South Australia was completed in the first half of 1863, and the communication on the Victorian side will shortly be further secured from interruption by a cross line from Hexham to Hamilton, now in course of construction. This will provide two independent lines between Melbourne and Portland, thus—one line direct to Portland, viâ Geelong, Colac, Camperdown, Warrnambool, and Belfast; and one viâ Geelong, Ballaarat, Beaufort, Streatham, Hexham, Hamilton, and Portland. From Portland the two wires are continued to the South Australian border on the same poles, which have been, I believe, renewed throughout.

Our communication with Melbourne and Sydney has been greatly improved since the completion of the second wire in Victoria. We are now able, as a rule, to work direct with Melbourne, thus saving the necessity for repeating at Mount Gambier; and in cases of long reports we can, if we wish, work with Sydney, a circuit of 1,300 miles.

Mr. M'Gowan proposes a system of telegraphic communication between the different public offices in Melbourne, which are very much scattered. Wheatstone's alphabetical instrument, of which twenty-six have been ordered from England, are to be used, and Siemens and Halske's india-rubber covered wire will be employed for connecting the offices.

Through the kindness of Mr. Cracknell, who introduced Professor Wheatstone's instrument on the railway lines in New South Wales, I had lately an opportunity of trying them here. They are exceedingly simple, and require but little or no experience to work them, and answer very well in short simple circuits with only two instruments, but not where there is much resistance. I have also imported two of Henley's magnetic alphabetical instruments. In these a much more powerful current is obtained; but, except in very practised hands, it is almost impossible to avoid tripping, or to produce the proper number of electrical pulsations to work the escapement. If the handle is started or stopped slowly, the index needles do not start or stop simultaneously; and it is exceedingly difficult, when working quickly, to stop the current at the proper letter without "slowing." This is effected very neatly in Wheatstone's instrument by means of the key-board; and if this could be combined with Henley's arrangement, I think we should have a serviceable alphabetical instrument.

In 1862 the receipts of the Victorian department were £26,834 19s. 8d. on 162,647 messages. The working expenses of the department were £33,340 2s. 3d., showing a loss on the year of £6,505 2s. 7d.; but Government telegrams are not included in the foregoing statement, as they are not paid for in Victoria; they numbered 49,038 messages, valued at £15,446 0s. 9d., thus making the total earnings of the department £42,281 0s. 5d. The free transmission of service telegrams, by inducing an extravagant use of the telegraph, is, in my opinion, a very serious evil and inconvenience to the public, whose private messages are thereby frequently delayed.

There were 78 stations open in Victoria, with 1,975¼ miles of line in operation, during the year 1862.

In New South Wales, under the able management of Mr. Cracknell—who, it will be remembered, came out with me—the telegraph is making most rapid strides, and contrasts favourably with the other colonies in yielding, so early in its history, a net profit on the outlay of from 6 per cent. in 1861 to 7¾ per cent. in 1862.

The total capital invested in telegraphic extensions, including £12,222 8s. 1d. for stations, up to the end of 1862, was £116,234 11s. 7d.

	£	s.	d.
The revenue in 1862 was	25,513	9	8
The working expenses	16,780	7	5
Profit	£8,733	2	3

The following statement shows the increasing utility of the department:—

				£	s.	d.
1860—Number of messages	53,951	Receipts		12,136	13	2
1861 „ „	74,224	„		16,542	8	9
1862 „ „	104,660	„		25,513	9	8

The following statement, showing the extensions completed since 1860 and their total cost, will be useful:—

Since Captain Martindale's report to September, 1860, the following new lines and stations have been opened:—

From Gundagai to Kiandra—98 miles in length; contract price, £50 per mile, and £25 per mile for 22 miles of wire on existing poles, which were erected as guide poles; cost, exclusive of stations, £4,726 4s. 4d. Stations opened—Tumut, 11th March, 1861; Kiandra, 16th October, 1860.

From Bathurst to Orange—35 miles; contract price per mile, £45 10s.; total cost, £1,730 11s. 11d. Orange station opened 21st December, 1860.

From Bathurst to Mudgee—length of line, 91 miles; contract price per mile, £44; total cost, exclusive of stations, £5,887 7s. 7d. Mudgee station opened 16th May, 1861; Sofala, 15th May, 1861; Windeyer, 6th August, 1862; Tambaroora, 3rd October, 1862.

From Gundagai to Deniliquin, viâ Wagga Wagga—length, 220 miles; contract price per mile, £46, and for a wire on existing poles from Gundagai to Tarcutta, 35 miles, at £16 10s. per mile. Wagga Wagga station opened 10th June, 1861; Deniliquin, 1st August, 1861; and Urana, 29th October, 1861.

On the 1st August, 1861, the line from Deniliquin to Moama, 51 miles, was purchased from the Deniliquin Telegraph Company at a cost of £2,820 8s., being 10 per cent. advance on the original outlay.

The completion of the above line to Deniliquin, and the purchase of the latter portion from the company, supply two distinct routes between Gundagai and Melbourne, a result which has proved of great advantage when interruptions have occurred on the direct line viâ Albury.

The next extension of importance is from Maitland to the Queensland boundary at Maryland, viâ Singleton, Muswellbrook, Scone, Murrurundi, Tamworth, Bendemeer, Armidale, Glen Innes, and Tenterfield; length, 375 miles; contract price, first section, from Maitland to Murrurundi, 100 miles, £46 per mile; second section, from Murrurundi to the boundary, 275 miles, £48 5s. per mile; total cost, £21,354 15s. 10d.

The stations were opened on the following dates:—Singleton, 25th February, 1861; Muswellbrook, 11th June, 1861; Murrurundi, 12th June, 1861; Tamworth, 10th October, 1861; Armidale, 14th October, 1861; Glen Innes, 20th December, 1861; Tenterfield, 8th November, 1861; and through communication to Brisbane was established on the 9th November, 1861.

From Goulburn to Braidwood—51 miles; contract price per mile, £41; total cost, £2,494 15s. Braidwood station opened 25th November, 1861.

From Campbelltown to Wollongong and Kiama—58 miles; contract price per mile, £38; total cost, £2,830 8s. 2d. Wollongong station opened 11th August, 1862; Kiama, 15th October, 1862.

From Mudgee to Wellington—48¼ miles; contract price per mile, £43; total cost, £2,505 19s. 10d. Wellington station opened 12th September, 1862.

From Grafton to Tenterfield—112 miles; contract price per mile, £39; total cost, £4,570 14s. 11d. Grafton station opened 17th December, 1862.

From Orange to Wagga Wagga, viâ Forbes (the Lachlan gold-fields), and (Young) Burrangong—225 miles; contract price per mile, £43. Forbes station opened 27th October, 1862.

This line is drawing near completion, and when opened through to Wagga Wagga will form a second and distinct means of communication with Victoria, viâ Echuca, and Sandhurst, so that only under extraordinary circumstances can an interruption between the two colonies occur, and which will render prolonged delays, from the crowded state of the lines, less frequent.

A second wire, between Muswellbrook and Scone, has also been provided for, to be worked by Wheatstone's alphabetical instruments. Contract price per mile, £20; total cost, £303 8s. 6d. The Scone station was opened 10th May, 1862.

PROPOSED EXTENSIONS FOR 1863.

A line from Deniliquin to Hay, an estimated distance of 80 miles. From Braidwood to Queanbeyan, 35 miles. From Wellington to Dubbo, 35 miles. An additional wire from Sydney to Newcastle.

Tenders have been received for the above lines at the undermentioned rates:—Deniliquin to Hay, £43 per mile. Braidwood to Queanbeyan, £37 per mile. Wellington to Dubbo, £41 10s. per mile.

These extensions have been guaranteed by the inhabitants of the districts they are intended to connect, that they will be responsible for the annual

payment of 5 per cent. (return by the lines) on the capital invested, after paying the working expenses.

In 1862 there were 2,174 miles of line, and 2,539 miles of wire at work in New South Wales, connecting 47 stations. In 1863 stations were opened at Hargraves, on the Mudgee branch, and East Maitland, on the north line; and Hay, Dabbo, and Queanbeyan will be opened shortly, making 2,344 miles of line at work.

In Queensland there are 200 miles of lines in operation, and new lines to Rockhampton and Port Denison are in progress.

At the end of 1863 the Australian colonies had about 5,521 miles of line, 6,850 miles of wire, and 175 telegraph offices, all erected in a little more than eight years.

TELEGRAPHIC COMMUNICATION WITH EUROPE.

It does not seem probable that any steps towards the realization of this project will be taken until we have had some experience of the working of the Euphrates Valley and Persian Gulf line to India, as it would clearly be premature to enter into any engagements for the Australian section before the communication between England and India has been completed and proved reliable; the present year will probably determine this. In the meantime, the Queensland lines are being pushed on to Port Denison, a loan of £85,000 having been authorized for that purpose; and the line from thence could easily be extended to the Gulf of Carpentaria, or to our new northern settlements near the Adelaide River, should the direct route from South Australia be for the present abandoned. There can, however, be little or no doubt that the latter will be ultimately carried out, if only to serve the purpose of an alternative line.

In my letter of the 27th December last, I have recommended that the Government should deal directly with the manufacturers of the cable, who should have the whole responsibility of laying it, and keeping it in good working order for the first year; or the cable might—perhaps with advantage—be leased to the manufacturers under suitable arrangements. The Malta and Alexandria cable is so leased from the Home Government by Messrs. Glass, Elliot, & Co., who made it; the term expires on the 1st January, 1867. The lessees have to keep the whole line in efficient repair, the land line and shore ends of the cable solely at their own expense, and in the event of any other portion of the cable becoming defective it is, if necessary, to be replaced by new cable, in all respects as good as the original cable when first laid, the Government providing the ships required for that purpose. Messrs. Glass, Elliot, & Co. also work the land line between Alexandria and Suez, under an arrangement for four years with the Telegraph to India Company, paying a rental to the latter of £2,500 per annum. The Telegraph to India Company purpose at once extending their lines from Cairo to El Arish, and thence to Beyrout, a distance of 400 miles, at an estimated cost of £20,000; from which point they contemplate its future extension to meet the Persian Gulf and Constantinople line near Diabecker, which will thus afford additional security against interruption west of the Euphrates Valley.

With regard to the submarine section of the Java-Australian line, it has been generally supposed that the depths would seldom exceed 50 fathoms, and that the nature of the bottom is favourable. No detailed soundings, however, appear to have been made between the east end of Java and for about 60 miles beyond Timor; but I learn from a valuable paper on the Submarine Plateaus between Asia and Australia, contributed to the *Journal of the Indian Archipelago*, by George Windsor Earl, Esq., M.R.A.S., that between the Asiatic and the Australian banks of soundings there exists a volcanic gorge, the narrowest part of which is between Timor, on the northern verge of the Australian bank of soundings, and Kalatoa, on the southern verge of the Asiatic Plateau, where it is about 180 miles across. Its depth cannot be ascertained by the ordinary sounding apparatus, owing, perhaps, to the strong current from the eastward; but Mr. Earl thinks it possibly does not exceed 1,000 fathoms. As the cable must cross the gorge, careful soundings will therefore have to be made. The bottom of both plateaus are favourable for the preservation of the cable, consisting mainly of clayey mud mixed with sand and shells, which is soft under water, but when exposed to the air becomes exceedingly hard. On neither plateau has any trace of volcanic action yet been discovered; but Mr. Earl states that "all the islands of the Indian Archipelago, which are not included within the submarine plateaus defined above, are of volcanic origin, and the greater number of the larger islands contain volcanoes in a state of activity at the present time." The course which Mr. Earl, from his knowledge of those seas, recommends the cable should follow is from East Java, along the Asiatic Plateau, "to its extremity near Kalatoa, where it crosses a gap 60 miles in width to the Iron Cape of Flores. This gap has never yet been sounded; but the depth is not likely to be very great, nor are the surface currents strong. The track then passes the Gut of Larantuka, a small Portuguese settlement, where the soundings vary from 13 to 50 fathoms, over a rocky bottom. On leaving the Gut, a second gap has to be crossed, nearly 90 miles in width, and through which the current sets to the south-west, almost without intermission, at a velocity near the surface of one mile and a half to three miles an hour, which, however, is very considerably less than the rate at which it rushes between Ombay and Timor." From Timor to the Australian coast there would be no difficulty or danger.

OBSERVATORY AND METEOROLOGICAL DEPARTMENT.

Meteorological observations have been continued at the different stations named in my report for 1861. The results for 1862 have been printed, and those for last year are in an advanced state. The instruments ordered for the lighthouses have arrived, and will be mounted as soon as I can arrange to visit the several localities.

Daily weather reports are exchanged with the other colonies, and I have recently arranged with Mr. M'Gowan and Mr. Ellery, the directors of the Williamstown Observatory, for a regular system of warning signals round the coast on the appearance of approaching bad weather.

I have recommended provision being made on the estimates for the erection of an elevated look-out and flag-staff at the Normanville Telegraph-office, by means of which vessels arriving from the eastward may be signalled much sooner than at present.

I have also recommended provision being made for a time-ball at the LeFevre's Peninsula Station, which I propose should be dropped by signal from the Observatory at one p.m. Adelaide time. The ball is to be sufficiently elevated to be seen at the port, as well as at the anchorage outside.—I have the honour to be, &c., CHARLES TODD,

Observer and Superintendent of Telegraphs.

The Hon. the Commissioner of Public Works.

CORRESPONDENCE.

PAPERS ON TELEGRAPHY READ AT THE MEETING OF THE BRITISH ASSOCIATION, HELD AT BATH.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—There are some material errors in the abstract report of a paper read by me before the British Association, "On Submarine Telegraphy," which I hope you will allow me to correct; and the discussion on Mr. Fairbairn's paper, "On the Mechanical Construction of the Atlantic Cable," as well as on my own, I regard as so important to the interests of telegraphic science, that I trust you will not deem any apology necessary for my giving you a more full account of them than that published in the local papers.

First, with regard to Mr. Fairbairn's paper, Captain Galton distinctly stated in the discussion that he for one did not consider the so-called consulting committee responsible for the mechanical construction of the Atlantic cable, now being put into the Great Eastern; nor was it such an one as they would have recommended on any other than financial considerations. Secondly, Mr. Fairbairn thoroughly acknowledged that the spiral outer wires could not in any way give increased tensile strength, particularly if the cable were allowed to revolve; and he also said that they, the scientific committee, had tried to remedy the faults of the cable submitted to them, but did not consider it to be the best possible. There was a table of figures exhibited, which showed the breaking strain, but not the diameter, or any other conditions of each of the cables submitted by different makers; and Mr. Fairbairn acknowledged that this table was not comparative, nor could anything be learnt from it, except that one maker's cable of an inch and an eighth diameter was stronger than another's of five-eighths of an inch; stronger, that is, in air, and of those sizes, for no comparison was made of the lengths of themselves they would support in water, if of equal external diameter. One would fain hope that the proximate result of all this will be the abandonment of those outer spirals which have really been the "arms of death" to too many unfortunate but well-insulated wires.

I now pass to my own paper, and, first, I complain that I am made to say, "I tell you engineers." I hope I never wrote or spoke such a presumptuous piece of folly. What I did write was, "We seamen tell you engineers," after guarding myself by also writing, "I claim only to be heard as the mouthpiece of my profession." Now this is very different, if not in the matter, yet in the manner, and I hope your readers will give me credit accordingly. The next error I have to observe upon is one affecting the size of the cylinder. I never was so foolish as to propose a cylinder of 22,000 tons burden to carry a cable which only weighs *in air* under 6,000 tons, even if I ever had advocated the employment of one cylinder instead of two, which I have not done. Two cylinders, each in tow of its separate ship, or two ships, offer always the advantage of halving the time necessary for the operation, for as they proceed together to mid ocean, and there commence laying, it is clear that only six or seven days, instead of twelve or fourteen, will be required for the two ends to reach shore. In the case of the Great Eastern, this advantage is necessarily given up.

I only mentioned a cylinder of 120 feet long by 90 in diameter as giving the tonnage of the Great Eastern* (22,000 tons), by way of showing those who fancy that a cylinder to carry as much cable must necessarily be as large as the ship, what a serious error they commit. The size of each of two cylinders, which would have been necessary to take the place of the Great Eastern in laying such a cable as the present Atlantic—say 2,500 miles of 35 cwt. to the mile in air, and $1\frac{1}{8}$th in diameter—would be 60 in diameter and 75 long, having a tonnage each of 6,057.

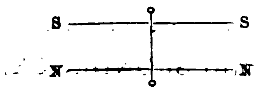
The arguments which I adduced in favour of the use of cylinders were so fully admitted, and my views on the subject of wave motion, as affecting the laying of cables were so strongly confirmed by almost all of the scientific men who spoke during a discussion which lasted two hours, that on this subject I have only to hope that the time is considerably nearer when the

* The beam of the Great Eastern is 83 feet, and her length 690; over paddle-boxes breadth is 114 feet.

system I have so long advocated will receive a fair trial; but I was pleased to notice that Mr. Allan's cable is also receiving a very greatly-increased portion of its well-merited commendation, and that there is no discouragement on account of the failures in submarine telegraphy, so marked as to amount to a mistrust of the future of this essential means of progress in the too long-delayed telegraphic union of the nations.

I had the pleasure of showing at the Bath meeting two interesting facts in electricity and magnetism, of which I shall soon be ready to give you a more detailed description. The first is a printing telegraph, the property of M. Delaye Lepaul, of Paris, which prints through a single wire in Roman characters at a speed of thirty words per minute. Any child who can spell can send by it. It is not liable to trip, and can be adapted as well to electro-magnetic as to voltaic currents. You may take out or replace thirty miles of resistance without any error being thereby caused, and nothing but ordinary printers' ink is employed.

The second is a magnetic curiosity in the shape of astatic needles joined as usual by an aluminium bar, the upper one of which has apparently no north pole, and the lower no south pole, thus—



These behave most curiously under the action of the galvanic current, as might have been expected, owing probably to the composition of the forces brought into play. It is a discovery of my own, which may possibly be of some value in the construction of future instruments, or in other magnetic research.

For the purpose of showing the action of a voltaic current on these needles, I used a new form of battery, which I strongly recommend to your student readers. It is thus formed:—Take a strip of copper, say twelve inches long and two wide; sew it up in linen, after passing through two holes a bit of copper wire for the terminal, which is soldered into its place. Roll it up into a helix with a piece of thick zinc (the ordinary thick zinc plate of commerce); this to be half an inch wider, and also to have its terminal similarly affixed. Put a little mercury in the bottom of an earthen or glass jar, and insert the two spirals. Fill up with acidulated water, and you will have a self-amalgamating constant battery cell of very little internal resistance, very cheap, very clean, and easily put in or out of action, its quantity being almost the greatest possible in the space. I have had the cell in action on short circuit through a galvanometer for two months, with only a change from 70° to 65°. The water was changed by an india-rubber syringe, which sucked it out and put in fresh—at the end of the first month very little sulphate of zinc showing itself. If not wanted, it is put out of action by lifting the two spirals out together, and putting them to drain on the top of the cell. Yours, &c.,

J. H. Selwyn, Capt. R.N.

A LESSON ON LEGISLATIVE AND EXECUTIVE FUNCTIONS.

To the Editor of the Telegraphic Journal.

Sir,—We are obliged by your insertion of our note of the 17th inst., and also for your comments thereon. There is some asperity in them, but, perhaps, the tone of our note induced it.

We demur to your dictum that Directors are "honorary officers." The Directors *issue* directions, and the officers *receive* directions. Confusion frequently arises from the line between legislative and executive functions not being kept clearly in view, and responsibility ceases to fall on the proper shoulders in consequence.

Our admirable British Constitution offers a ready and apt analogy. The shareholders represent the constituents, the Directors are the Legislature, and the officers the Executive. The highest officers of state are only "Secretaries of State," and the Prime Minister himself is but "First Servant" (in plain English) of the Legislature.

If you open your columns to remarks upon this subject, you will, we think, receive many interesting communications.

We are, sir, your obedient servant,

Universal Private Telegraph Co., Lewis C. Hertslet, Sec.
London, 26th September, 1864. Nath. J. Holmes.

TELEGRAPHIC NEWS.

Malta and Alexandria Telegraph.—On the 26th ultimo a telegram was received by Messrs. Glass, Elliot, & Co., announcing the re-opening of the Malta and Alexandria telegraph for the transmission of messages to Egypt, India, China, Australia, &c.

The Atlantic Telegraph.—Mr. C. W. Field, the original projector of this great enterprise, was in Pictou, Nova Scotia, on the 20th of August, and was the guest of Major Norton, the American consul, by whom he was hospitably entertained. Among the guests present were the editors of the *St. John's News* and *Globe*; Mr. Hoyt, the manager of the Nova Scotia telegraph line; and other gentlemen. The evening passed very pleasantly, the company listening with much pleasure to the statements made by Mr. Field relative to the proposed laying of the cable.—*Canadian News.*

A New Company.—We learn that the Messrs. Crossley, of Halifax, the great carpet manufacturers, are about to transfer their extensive business and premises to a company (limited), with a proposed capital of £1,650,000, in 110,000 shares of £15 each, of which it is intended to call up not more than £10 per share. We note this fact as Mr. L. J. Crossley has for many years evinced a great interest in telegraphic pursuits.

The New Telegraph Cable to Fortress Monroe.—A submarine telegraph cable of English manufacture has arrived at Fortress Monroe. It is to be laid across the Chesapeake Bay from Fortress Monroe to Cherrystone. The old cable has been useless for several weeks.—*American Artizan.*

Alarming Fire at the Telegraph Offices in Threadneedle-street.—About eleven o'clock on Monday night, the 26th ultimo, a serious fire occurred at the City terminus of the Submarine Telegraph Company and the British and Irish Magnetic Telegraph Company, Threadneedle-street, City. At that time smoke was observed to be issuing from the roof, and soon afterwards flames broke forth from a room on the fourth floor, which was filled with stationery and stores to the value of £500, belonging to the Submarine Telegraph Company, and contiguous to a room filled with their instruments, connected with Continental wires. The room had only been closed for a few hours when the fire was discovered. The night clerks on duty made an effort to extinguish the fire by running up a length of hose fixed to a hydrant on the second floor landing; but the force of water was so feeble that it dropped short of the fire. On the arrival of the firemen a delay of ten minutes occurred before water could be procured from the New River Company's mains, but when the engines were got into work the flames were prevented from descending to the lower part of the building, but the Baltic wine stores, which were on the basement, were a good deal damaged by water. The following letters have been received from the several offices, from which we learn that the damage is not so serious as was at first supposed:—"Sir,—I am instructed to inform you that a fire broke out about eleven o'clock last night in this building, which has destroyed this company's instrument-room and instruments, and consequently has occasioned some delay in the transmission of messages. However, through the kindness of other telegraph companies in lending us instruments, we were enabled to re-establish the direct communication with Paris and Brussels at an early hour to-day, and we trust that in the course of to-morrow all our lines in connection with the Continent will be in working order, so that messages will be transmitted and received as usual. It is satisfactory to state that the property destroyed is amply covered by insurance.—I am, Sir, your obedient servant, S. M. Clare, Secretary.—Submarine Telegraph Company, 58, Threadneedle-street, E.C., Sept. 27." "Sir,—I beg to inform you that the fire which took place at this station last night has not in any way interfered with the communication to the Continent, or to any station in the United Kingdom. Messages are accepted and despatched as usual.—By order, J. Newbury, Station-master.—British and Irish Magnetic Telegraph Company, Central Station, Sept. 27."

Military Telegraphs.—The Select Ordnance Committee, recently appointed by the Admiralty and the War Department to inspect and report upon the improved systems of day and night telegraphing in military and naval operations, combined or independently of each other, have returned to town from the Isle of Wight. They have completed their labours, with the exception of the official presentation of their report. The committee arrived at Portsmouth on Tuesday, the 20th ultimo, from London, and, embarking on board Her Majesty's paddle steamer Pigmy, Master Commander Vine, left the same afternoon for Ventnor, Isle of Wight, where they landed, accompanied by Captain Bolton and Commander Colomb. They proceeded thence to the signal station on St. Catherine's Down, near Black-gang Chine. It was to be made the head-quarters of the committee during their stay in the island, and become also the signalling head-quarters during the intended exposition of the results of Captain Bolton's and Commander Colomb's labours for the information of the committee. The signal station on St. Catherine's Down was under the command of Captain Bolton, and was furnished with the Holmes magneto-electric light and Captain Bolton's field lime-light, as supplied to the telegraphic corps of the Royal Engineers for night signalling, and a Venetian blind shutter apparatus and a set of naval code flags for day signalling. Two men of the Royal Engineer telegraphic corps formed Captain Bolton's staff. Ashy Down, 7½ miles inland from St. Catherine's Down, was another appointed station on the island, and one of the field lime-lights for night signalling, with a double collapsing cone for day signalling, were stationed there in charge of two men of the Royal Engineers. At the semaphore tower in Portsmouth Dockyard, 14¾ miles from St. Catherine's Down, was placed a non-commissioned officer of the Royal Engineers with two signalmen, in charge of a field lime-light for night signalling. Her Majesty's steamer Pigmy was in charge of Commander Colomb, in positions out seaward as required, and was fitted with one of the magneto-electric lights (of the same description and power as the one on St. Catherine's Down), a field lime-light, and a flashing apparatus for night signalling; a double collapsing cone and a steam jet for day signalling. In the *Telegraphic Journal* we gave a general description of the magneto-electric and lime-lights, and the means of day signalling by the cone, shutters, and steam jets. It is therefore only necessary on this occasion to draw attention to the fact that Captain Bolton and Commander Colomb's system of signalling may be said to be based on the "Morse" systems of telegraphy, the long and short dashes in the printing of the "Morse" telegraphic message being efficiently and simply represented

in the Colomb-Bolton system by the length of time in which the double collapsing cone, Venetian shutters, or any other dark object is exhibited by day, or by the length of time in which the magneto-electric and field lime-lights on shore, or the plain flashed lamp at sea, are exhibited by night. Colours are totally discarded in these signals, for the reason that a plain white light by night will transmit its message to a much greater distance than any coloured light possibly can do, at the same time that the apparatus is simplified by the use of one kind of light only to a *minimum* point; and a dark opaque object, such as the collapsing cone or shutter apparatus, is preferable, for the same reasons, to coloured flags by day. The steam-jet signals remain to be noticed. The efficiency of this mode of communication from a vessel at sea to a headland on the coast was discovered in a very curious manner. One day during the recent experiments which have been carried out between Captain Bolton, on St. Catherine's Down, and Commander Colomb, on board the Pigmy out at sea, communication from the Pigmy became very difficult owing to the distance from the land and the peculiar state of the atmosphere. The hull of the Pigmy could just be discovered at sea from the Down; but it was quite impossible to distinguish masts or yards, and therefore equally impossible to read any signal by the cone. While she was being watched as she lay thus by Captain Bolton and his party on the Down, three or four white dashes (thrown off steam) of different lengths stood out most prominently over the steamer's hull, against the dark horizon in the background. These white dashes, or escaped lengths of steam, furnished the hint for the steam-jet signal. A steam vessel lying so far off from the land that, like the Pigmy, her ordinary mode of day signalling would be useless can, by throwing off jets of steam, print off her message in long and short dashes against the darker background over the horizon as certainly and as legibly as the electric instrument on shore prints off its dots and dashes on its paper riband or tape. On Wednesday morning, the day succeeding the arrival of the committee at St. Catherine's, they were employed in discussing the reports handed in by Captain Bolton and Commander Colomb, with which they expressed the greatest satisfaction. On the afternoon of the same day Her Majesty's ship Pigmy proceeded to sea, and when four miles off St. Catherine's commenced steaming out slowly from off the land and signalling to the committee on St. Catherine's Down with ordinary naval flags. At six miles and a half distance the flags failed altogether, being then at too great a distance to be distinguishable from the Down, and signalling was then commenced with the flashing system, the shutter apparatus, the double collapsing cone, and steam jets. It was kept up for some time at an average distance of seven miles, and always at a greater speed than that gained by naval flags at one-third the distance. On Wednesday evening night signalling was commenced between the Down and the Pigmy, twelve miles at sea, with the lime-light, and was continued at a great speed up to fourteen miles distance, when the magneto-electric light was brought into play, and continued the signalling up to seventeen miles. Messages were also forwarded direct to Portsmouth Dockyard, and answers received in return, and also to the station on Ahsy Down; but the most interesting portion of the signalling was between the bold headland of St. Catherine's and the Pigmy, out in the Channel. On Thursday the committee were employed in carrying out experiments in field signals with Captains Bolton and Colomb's apparatus, and rapid communication was kept up at will, by day and by night, between two moving parties two miles distant from each other. This concluded the experiments, and the committee expressed their warm approval with all that had been submitted to them for examination. It is understood that immediate measures will now be taken, on the recommendation of the committee, to introduce permanently the combined Colomb-Bolton system into the army and navy as the signal code for both services in all future operations by land or by sea, whether singly or in conjunction with each other.

MISCELLANEA.

£600 Reward.—The proprietors of one of our contemporaries advertise that they will give £600 reward to any one who will catch a director asleep on a railway, and frighten him into a belief that the safety of his throat and pocket are threatened, so that he may come to practical conclusions as to the necessity for communication between the traveller and guard.

The Saving of Life by Railway Travelling.—A writer in a recent number of the *Revue des Deux Mondes* computes the average yearly loss of life on railway journeys as 1 in 7,000,000 travellers whereas 70,000 in 30,000,000 travellers would be no more than the fair proportion to the annual loss of life in former days among travellers by land and sea.

The Production of Sulphur in Italy.—During the last ten years great improvements have been introduced in the method of extracting sulphur from calcareous gangue. It is always obtained by liquefaction by burning a portion of the ore; but this operation, formerly performed in small open cylindrical furnaces (*calcarelle*), is now effected by simply heaping the stones and covering them with earth, as in the process of charcoal burning. The sulphur at present produced in Italy amounts to no less than 800,000 tons a year, the value of which in the rough state is 30,000,000 francs. This yield, which has increased ten-fold since 1830, is furnished in great part by Sicily. The quantity produced in Romagna, formerly but small, has since increased to 8,000 tons per annum.

Increased Explosiveness of Mining Powder.—Mr. Nobel announces that by damping mining powder with nitro-glycerine its explosive power is trebled, and the noise of the explosion much less than when ordinary powder is used.

Electricity in Combination with Gas.—The insidious element of electricity is being applied as a motive power, and may some day, not very remote, outstrip even the wonderful achievements of steam. By its great power we speak from continent to continent, and space becomes annihilated. Who can say that it will not yet become the greatest and most useful agent ever known? Already we find the principle being illustrated, in combination with gas, in the Lenoir Gas Engine. The inventive genius of the times has grasped the idea; its development will be sure to follow.—*American Gaslight Journal and Mining Reporter.*

Silvering.—Cold silvering may be performed on brass and copper which is well cleaned and quite bright, by rubbing with a moistened cloth, dipped in the following powder:—1. Chloride of silver, 2 parts, pearlash, 6 parts, salt, 3 parts, whiting, 2 parts; mix. Or, 2. Precipitated silver, 1 part, common salt and cream of tartar, each 2 parts; mix. When the metal is silvered, it should be washed in a hot weak solution of alkali, and then washed dry. Other silvering powders are:—3. Nitrate of silver and salt, of each 1 part, cream of tartar, 7 parts. 4. Nitrate of silver, 1 part, cyanide of potassium, 3 parts. 5. Bath: Nitrate of silver, 15 parts, sulphate of soda, 100 parts; dissolve in water, and dip the article into the solution.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2307. C. W. Howell, improved means or apparatus for communicating from the passengers or driver to the guard of a railway train.
2312. F. Hovenden, improvements in railway signal apparatus.
2341. A. V. Newton, improvements in the mode of and machinery for manufacturing telegraphic cables.—A communication.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2047. T. P. Tregaskis, the improved use of magnets in overbalancing weights.
2127. J. Packer, improvements in signals in railway trains.
2158. A. M. J. Count de Molin, an improved electro-magnetic engine.
2182. W. J. Curtis, improvements in railway carriages and in the means to be employed by passengers in signalling to the guards of railway trains.
2217. H. W. Cook, improvements in electric telegraphs.—A communication.

PATENTS WHICH HAVE BECOME VOID.

2292. F. Barnett, improved automatic electric signals to prevent collisions on railroads and railways.
2298. T. M. R. Weare, and E. H. C. Moncton, improvements in batteries for obtaining electric currents and the products therefrom.
2303. J. Reeves, improvement in electro-magnetic engines for obtaining and applying motive power.
2310. R. A. Brooman, improvements in apparatus for stretching, supporting, and uniting telegraph wires.—A communication.
2411. I. L. Pulvermacher, improvements in apparatuses for creating electric currents, chiefly for medical purposes.

NOTICE TO PROCEED.

1223. E. W. Farrell, improvements in the method of and apparatus for communicating between the guard and the engine-drivers of railway trains.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6	per lb.

India Rubber.

Para, first quality	1/8½ to 1/9	,,
second ,,	1/5 to 1/6	,,
third Negro-head	1/2½	,,
Java and Penang	1/3 to 1/5	,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	104½ to 105	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	⅜ to ⅝	—
5	United Kingdom Telegraph .	3	1 to ½ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 3½	—
5	London District Telegraph Co. .	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to par	—

THE TELEGRAPHIC JOURNAL.

Vol. II. No. 41.—October 8, 1864.

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DOMESTIC TELEGRAPHS.

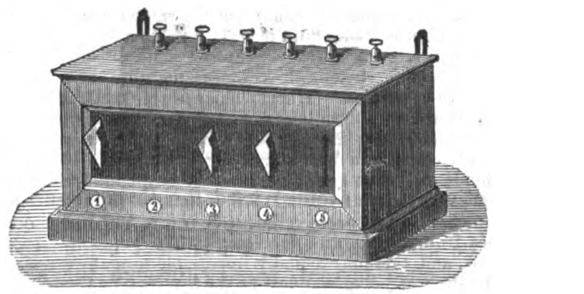
Some few weeks since the attention of the public and the readers of this journal was called to the employment of electricity for domestic purposes, in an essay by Mr. W. H. Preece, Assoc. Inst., C.E.

The remarks made by the author, showing the great superiority, in every respect, of the electric over the mechanical method of hanging household bells, induced Mr. Francis Wyatt Truscott, of the firm of Truscott, Son, & Simmons, the printers and publishers of this journal, to apply the new system to his residence, 5, Park-crescent, Portland-place.

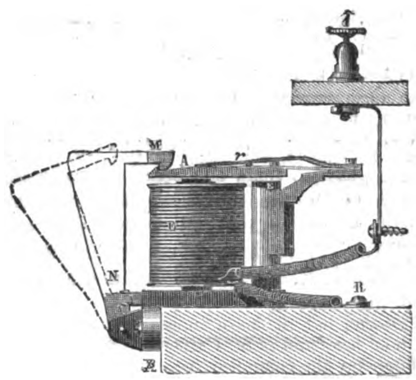
Great difficulty is always experienced in introducing novel and untried systems into use in this country. Prejudices have to be overcome, fears dissipated, and confidence secured. The purest logic may prove the new thing to be perfect and faultless, but unless the questions "Where is it at work?" "Who has used it?" can be satisfactorily answered, the persevering introducer has to meet with nothing but shakes of the head and shrugs of the shoulders. The greatest anxiety may be evinced for its welfare; every satisfaction may be expressed with its practicability; but no one will venture to undertake the responsibility of being the first to adopt it for practical use. How George Stephenson had to hammer railways into the thick heads of Parliamentary Committees! and how Cooke had to sigh for years before he could secure assistance to introduce his telegraph! So with the application of electricity to domestic purposes. Many have expressed their approval of the principle, but few have cared to incur the risk of success or failure in its introduction to English homes and English hearths. Mr. Truscott has prominently stepped forward and taken upon himself the responsibility of introducing the electric system into general use in England, and too much credit cannot be given to him for raising himself above those petty prejudices which invariably surround projectors and their novelties.

Mr. Truscott has had his house completely fitted up with the new system. Its superiority over the old arrangement is most apparent. The ease and freedom with which the buttons are pressed—the slightest pressure being sufficient to sound the bell without the necessity of exerting that violent pull which distinguishes the old bell-crank—the tranquillity and noiselessness with which the power circulates through the wire—the absence of all disfigurements to the walls and passages—and the simplicity with which the different rooms are distinguished—not only render this system a vast improvement upon existing plans, but prove it to be an elegant scientific principle.

As a description of the work carried out may be interesting to our readers, we append, from personal observation, the following remarks. The system selected by Mr. Truscott is that known in France as "Bréguet's." Immediately outside the servants' hall are placed the indicator and the bell. The indicator is fixed four feet from the ground, and the bell immediately above it. The indicator (whose general appearance corresponds with the following sketch, only that instead of having five



indices as shown, it possesses sixteen, in two rows of eight each, each index corresponding to a room, and having the name of the room painted above it,) is placed low, to enable the servant to restore the indices to their normal position as soon as he has responded to its call. The interior construction of the indicator and its action are shown in the following sketch. When a current of electricity, generated by the pres-



sure of a button in any particular room, passes through the electro-magnet (E), the armature (A) is attracted, and the metal piece (M N) falls by its own gravity, as shown by the dotted lines, and appears through a slot in the ebony front of the indicator. 1, 3, 4 indices are shown as having been depressed in the first figure. These indices are painted white to render them more visible. They are restored to their normal position by pressing them back with the finger.

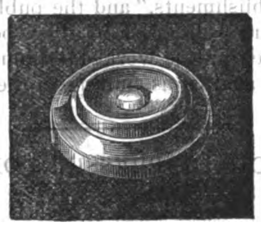
The same current that releases the pointer rings the bell, which is an ordinary trembling bell, as fully described in Mr. Preece's paper. One bell thus acts for every room in the house, and the particular room that rings is distinguished by its pointer on the indicator.

The battery is placed in a cupboard near the indicator, and is the ordinary sulphate battery.

The wires, insulated with a thin layer of india-rubber and covered with a protecting coating, are carried from floor to floor up a wood shooting, and branch into each room between the joists and beneath the flooring.

The terminal wire of the indicator is connected, through the bell, with one terminal of the battery; the other terminal is carried, by a wire, upstairs, with a branch to the buttons or pulls in each room, dining, breakfast, library, billiard, drawing, bed-rooms, &c., to the top of the house. From each "button," or "bell-pull," a second wire is carried direct to the indicator, connected to the terminal corresponding with the name of the room. In several of the rooms many buttons are

fixed (for instance, in the drawing-room there are *four*); these are simply branches from the main one.



The buttons (see sketch) used are those described in Mr. Preece's paper, and consist simply of a rubbing contact. It can thus be easily seen that, on contact being made in any room, the electric current, passing through the button, steals noiselessly along the wire to the indicator, passes through the electro-magnet, and, attracting the armature, exposes the indicating piece, rings the bell,—calling the servant's attention—and returns to the other pole of the battery.

On the servant hearing the bell he will immediately see, from the indicator, whose attendance is required, and in what room; and before attending to the summons he will restore the indicator to its normal state, by simply pressing back the weight until it is caught by the armature. In the bed-rooms and bath-room, in addition to the ordinary "button," a silk cord, containing wires with a spring contact at the end, is fixed, this being used in bed or in any spot where it would be difficult for any one to touch a button.

Besides the communication between the rooms upstairs and the servants' hall, separate communications are made from the hall and the drawing-room landing to the nursery and servants' rooms, and also from the best bed-room to the nursery.

Everything acts in the most satisfactory way, and great credit is due for the manner in which the work has been carried out. We believe it was completed under the superintendence of Mr. G. E. Preece, whose name is well known to the readers of this journal.

ERRORS IN TELEGRAPHIC MESSAGES.

In scientific investigations, in chemical manipulations, in commercial transactions,—indeed, in all terrestrial affairs, if we except the giving of evidence in a court of justice by an "active and intelligent officer," human kind evince a liability to error. If we project railways, and a speculative mania ensues, involving thousands in ruin; if we build a leviathan ship, and, on its completion, are unable to get it off the stocks; if we manufacture a telegraph cable to connect the Old with the New World, and sink it in mid ocean, useless, except as a plaything for the monsters of the deep,—a great outcry is raised, and somebody is found to be at fault. Englishmen will exercise their prerogative of grumbling, and sometimes find an occasion to improve in the telegraph service. Complaints of inaccuracy are now and again preferred against telegraph clerks, whose business is of an important, though critical character, when contrasted with ordinary mundane operations. To account for these murmurings, and to indicate where the evil sought to be remedied not unfrequently originates, are the objects of the following remarks. Manuscript is often tendered to signallers which would puzzle an expert to decipher, and the bearer of the despatch is found to be as uninformed of the nature of its contents as was Diogenes of the velocity of light. There is no time for enquiry or reference, off the telegram must go, as accurate as practicable under the circumstances. On reaching the nearest station to its destination, the bulletin is again liable to misadventure. The code of signals employed (as the Morse instrument has now found its way on to most European lines) is sometimes open to mis-interpretation, owing to the similarity of words, the approximate identity of characters, and the absence of stops in most messages.

Of probable mistakes on lines where the practice of reading by sound is adopted, Mr. Todd, superintendent of telegraphs in South Australia, thus speaks:—"Many errors occur in the rendering of words having a similarity of sound, such as 'to' for 'two;' 'for' for 'four,' &c.; and from the code signals of two different words closely resembling each other unless sent carefully; for example, in one instance the word 'tons' (— — — — — · · · ·) was substituted for 'kegs' (— · — · — — · · · ·), the operator transmitting the word thus (— · · · · · · — · · ·). 'Meet' (— — · · —) is likely to be read 'get' (— — · · —)." "In India," says Sir W. B. O'Shaughnessy Brooke, "the errors are chiefly in numbers, 'six' for 'sixty,' 'fifteen' for 'fifty,' and the like. Names of places and persons, especially of natives; 'purchase' for 'purchased,' 'insure' for 'insured,' 'ship' for 'shipped,' 'about' for 'above,' 'bales' for 'sales;' 90 mistakes in every 100, arising from the confusion of similar sounds in words of different meaning, or the omission of a letter or a syllable."

Another class of errors is well illustrated by the following order received by a London merchant, to ship "forty tons of *fog* to the Mediterranean." This novel cargo was manufactured from the abbreviations usually accompanying an order to deliver goods *free on board*, the initial letter b (— · · ·) in the last word, having been rendered g (— — ·), by the phenomenon known as the retardation of electrical signals. "Your wife has a fine *boy* this morning," was intended to intimate the birth of a son; the letter x (— · · —) being very similar to y (— · — —). "Don't come—too late," was a message once sent from Edinburgh to a medical gentleman in London, but, being delivered without the pause, it read "Don't come too late," upon which he started off, and only found out the fact that in telegraphy punctuation is ignored, after having performed a wearying journey of 400 miles. Mistakes of this kind are not so frequent now as formerly, as a more skilful class of manipulators preside at the stations. Receiving (and here we speak professionally) a message is not so simple a matter as many people imagine. To decipher dashes and dots, made on a paper tape, or to translate from the dictation of a machine, and to write in a legible hand the utterances of the electrical automaton, is an art only to be acquired by many years of patient application. That instances of gross neglect and culpable stupidity do occur on the part of signallers, we are fain to admit; but they are the exception to a commendable rule. An amusing anecdote is related, by Mr. Prescott, of an American gentleman who sent a despatch to parties in New York, requesting them to "forward sample forks by express." When the message was delivered, it read thus:—"Forward sample for K. S., &c." The parties who received the despatch replied by asking what samples K. S. wanted. Of course the gentleman came to the office and complained that the message had been transmitted wrong, and the operator promised to repeat it. Accordingly he telegraphed the New York operator that the despatch should have read, "Forward sample forks." The New York operator, having read the telegram wrong in the first instance, could not decipher it differently now. He replied that he did read it "sample for K. S.," and so delivered it. "But," returned the Boston operator, "I did not say 'for K. S.,' but 'f-o-r-k-s!'" "What a stupid that fellow is in Boston," exclaimed the New York operator, in a rage, "He says he didn't say 'for K. S.,' but 'for K. S.!'" The Boston operator tried for an hour to make the New York operator read it "forks," but, not succeeding, he wrote the despatch on a piece of paper and forwarded it by the mail, and it remained a standing joke upon the line for many months afterwards.

The data on which our knowledge concerning errors in telegraphy is based is of a local character, yet sufficiently com-

prehensive to show that the telegraphic operators have, in a few years, attained a very extraordinary degree of accuracy. It is difficult to obtain reliable information as to the internal economy of English telegraph lines, because they are in the hands of private individuals, who preserve records of their default, but who are very chary in publishing them to the world, lest they should evoke adverse criticism. Well, there may be a modicum of wisdom in this course, but a higher intelligence is evinced by the superintendents of telegraphs in our colonies and dependencies, who render, from time to time, statements of interest, and statistics of value, which enable us to estimate the proportion of errors in a given number of words or messages.

Sir W. O'S. Brooke, in his report of the telegraph service in India, observes:—"In 1859-60 I ascertained that of 105,893 messages sent in Bengal, Bombay, Madras, the East Coast, Ceylon, Scinde, and the North-Western Provinces, 1,605 contained errors, being one message erroneous in every sixty-five. The 105,893 messages contained 2,342,812 words, of which 1,982 are erroneous, being one word erroneous in 1,182." The superintendent of telegraphs in South Australia also furnishes us with some particulars on this subject. He says:—"It may be safely assumed that no important errors or delays, involving pecuniary loss or serious inconvenience, occur which do not come before me. Now, out of the 86,411 messages which passed through our offices during the year 1863, I have a record in my letter-book of sixteen being referred to me containing mistakes; and, as far as my memory serves me, scarcely as many more came under my notice, which were replied to verbally." On home lines the per centage of errors is much less, which may be attributed to the circumstance that the operators are more careful, skilful, and intelligent, than their colonial brethren.

The degree of accuracy attainable is dependent upon a variety of local circumstances, and can only be appreciated by those who have a full knowledge of the practical working of electric telegraphs. On lines where numerous foreign messages are transmitted daily by operators but imperfectly acquainted with languages, there is a possibility of as egregious blunders as would be made by an untaught Esquimaux set to compose a Greek ode. In the telegraphic, as in the printing profession, it is desirable that the manipulator should be able to comprehend a writer's meaning with facility; for as general intelligence is evinced by an operator, in proportion will errors diminish. In the instructions issued by the press to contributors and correspondents, it is insisted that all manuscript be written in a bold, clear hand, on one side of the paper only, or the communication will be consigned to the waste-paper basket. Now, if some such regulation were imposed by the managers of telegraph companies, the public would exercise more care in the preparation of messages, and thus the liability to error in deciphering them would be considerably reduced. In time, improvements may be effected in telegraphy which will render mistakes almost impossible. Inventors, not a few, among whom we may mention Hughes, Lepaul, and Thompson (of Paris), are working to perfect synchronous printing instruments, and if they succeed in establishing them upon our circuits, one fruitful occasion of error will be removed in the "receiving" of telegrams.

The public seem to think that telegraph clerks are infallible, and when a "bull" is made, be the consequence ever so trivial, no condemnation is too severe for the accessory before the fact. "I'll write to the *Times*," is the "boggie" to an unfortunate operator. This is unfair. To publish to the world an instance of default, and to ignore the generally correct manner in which telegraph messages are transmitted, is unworthy conduct, and only receives countenance from the press at the end of a session, when even the lucubrations of a "Bee Master," narratives of pseudo-spiritual *séances*, and disquisitions on nothing-in-particular, prove acceptable. "Mistakes will occur in the best-regulated establishments," and the public (having the right to expect every care to be used in their behoof) should never forget that the telegraph is worked by mutable creatures, who are as often sinned against as sinning in their vocations.

ON THE EFFECTS OF PRESSURE ON INSULATION.

By Amicus.

In the recently published "Report of the British Association for the Advancement of Science for 1863" there appears a contribution from Mr. C. W. Siemens, "On the Electrical Resistance and Electrification of Some Insulating Materials under Pressures up to 300 Atmospheres." This is an important subject rather; and as it appears in the annual of the first association in the kingdom, it is important that its statements, if erroneous, or even doubtful, should not go unchallenged. The "Reports of the British Association" will be cited and quoted from years hence by eminent men yet unborn, as records upon which implicit reliance may be placed; for if they are not the periodical indications of the advancement of science, what are? It becomes our bounden duty, therefore, to sift, examine, and correct everywhere correction is required. And these formidable tomes require the process as much so as less pretentious publications. Greater care, however, should be exercised by those who contribute any "Report of Researches in Science," not only in the making of experiments, but in the way the record *is* made, and the impression that is likely to be consequent thereupon to ordinary readers. We have no right to assume that Mr. Siemens has not correctly recorded the actual results of carefully-made experiments, but we have a perfect right to complain, nay, object, to the conclusion at which he arrives, and the impression which his paper is obviously intended to produce.

The "some insulating materials" experimented on were gutta-percha and india-rubber, and a combination of the two; that is to say, telegraph wires insulated with these materials. It does not appear—but, perhaps, we may assume—that these three descriptions of insulated wire were covered to one uniform thickness; they certainly should have been, in order to obtain accurate results; and the conductors also should have been uniform in construction and diameter: but this was not the case, the gutta-percha line being a strand of three wires, and the india-rubber a single No. 16 copper; while the third was, perhaps, a nondescript altogether, like its insulation. Uniformity in diameter of conductor and insulator are necessary conditions in order to accurate results; consequently, if in no other consideration, these experiments are wholly untrustworthy, since these were wanting; and a careful experimentalist should never think of recording the results of his studies if he is not able to fulfil all the conditions required; still less is he justified in publishing them to the world as irrefragable data for future guidance. Made known as singular phenomena, which might or might not be an approximation to the truth, and which other and more accurate experiments might confirm or explode, no fault could be found with them, and they might justly be classed with many other curious things, which, if they serve no other purpose, have the commendable quality of stimulating inquiry, and conducing to the elucidation of doubtful phenomena.

In addition, however, to this want of uniformity in size and construction of the lengths of insulated wires experimented upon, there is another, and still more grave objection, to be urged against their being accepted as reliable results as to certain conditions under certain circumstances of different insulating substances. One hardly knows what to admire most—the self-satisfied air with which Mr. Siemens quietly assumes the perfectness of the manufacture of his peculiarly constructed india-rubber wires, or the ingenuous candour which admits their infinite inferiority to gutta-percha wires. The eminent experimentalist unwittingly saps the foundation of his own arguments, and proclaims indirectly the utter worthlessness of the experiments he is at so much pains to record.

Except in the imagination of Mr. Siemens, the belief that a good insulated india-rubber line can be made by his process does not exist. The idea of perfect insulation being obtained by longitudinal strips, whose fresh cut surfaces are made to adhere by compression, is happily one that no individual whose opinion is worth anything ever for one moment entertained. They will tell you the process is ingenious, the machine a clever contrivance, and the designer no ordinary man; but they will never assert that he can make a good

wire by the process, still less will they be found to recommend insulated conductors so manufactured. Of course Mr. Siemens sets out from excellent premises. It is an unquestionable fact that fresh cut surfaces of india-rubber will permanently adhere, and become as one solid mass by compressing without the use of any solvent; but no one is so absurd as to believe that the compression at every individual point of an insulated wire, inch by inch, yard by yard, and mile by mile, can possibly be made sufficiently effective as to be implicitly relied upon. The thing is simply impossible without an amount of labour, supervision, examination, and re-examination wholly unprecedented, and in total incontinuity with the production of a core at a reasonable price. Nor is it to be depended on that even then the manufacture would ever be sufficiently satisfactory to warrant its use. Assuming, however, that you succeed in getting perfect adhesion of the rubber strips at every point, it must not be forgotten that you embed between the two strips a hard substance totally incompressible, comparatively speaking; hence, certain portions of the rubber will inevitably be held at a great tension; consequently, when the pressure is removed this portion of the insulation will have a tendency to return to its normal condition, and in doing so will, at a weak point, infallibly sever, in part if not wholly, the point of adhesion, and so the insulation will necessarily become defective. It was a want of confidence in his own invention that first led Mr. Siemens to advocate a mongrel insulation of part gutta-percha and india-rubber, and this combination he at one time asserted to be infinitely superior to either the one or the other singly; but experience having proved beyond all doubt that this combination is the least trustworthy of all species of insulation, on account of the entire absence of consanguinity between the two materials, he abandons both the bantlings which he brought forth with so much labour; and, indeed, had so little love for his own offspring as only to afford them a provisional protection, for he never had sufficient faith in them to complete the patent of either one or the other.

This, then, is the description of india-rubber wire on which Mr. Siemens experimented, and necessarily with most unsatisfactory results—it could not be otherwise. The wire was, without a doubt, defective; if it were not, then it was a miracle of manufacture, since it may with perfect safety be said that a mile of perfectly-insulated wire has never been made by this method, and probably never will. Here, then, is the ground of objection to Mr. Siemens' assumption, that while the "electrification of gutta-percha is increased in proportion to the increase of electrical resistance by pressure, the electrification of india-rubber decreases with the pressure in a ratio surpassing the decrease of electrical resistance." This postulate wants to be differently worded; for "the electrification of india-rubber decreases," &c., read "the electrification of Messrs. Siemens' india-rubber wire decreases," &c., and you will have the correct rendering. Without a doubt the pressure of 300 atmospheres, or half 300, would have the effect of causing Mr. Siemens' novel insulation to split its new spliced sides, and laugh at the futility of such a notion. But although the promising bud of "provisional specification" never blossomed into the flower of "patent completed," still Mr. Siemens did not abandon his production—far from it. A man can scarcely have a higher estimation of his progeny than to believe in their absolute (mechanical here) perfection. Such an overweening regard for one's own may be pardoned, providing it does not lapse into absurdity, and do positive injury to higher interests. In this case a limping, puny, sickly chit is made to usurp the graces, perfections, and consummate proportions of Adonis; and this we might excuse, providing its decrepitude and comatose constitution were not also laid upon his matchless shoulders.

The complaint, then, is that Mr. Siemens should assume that india-rubber is not only improved in the matter of electrical resistance under pressure (in water), but rather deteriorated; and it is objected to because the experiment was made upon a wire, the manufacture of which necessarily entailed imperfectness in the insulating envelope; and every one, therefore, must protest against a piece of egotism which assumes perfection where it does not exist, and publishes to the world as *bonâ fide* results, characteristics of a certain material, from defective and untrustworthy data.

Again, Mr. Siemens is at issue with others who, as authorities, are second to none. We must place our trust in respect to this matter either on Mr. Siemens or the gentlemen who had to do with the experiments conducted for the Government. Professor Wheatstone says (Government Report, p. 286):—"Pressure greatly improves the insulation, but the effect is more obvious as the material is a worse insulator. There appears to be less difference in india-rubber when subjected, and not subjected to pressure, than upon any other of the materials experimented upon." And this is fully borne out by the experiments conducted by Mr. Owen Rowland in the report above quoted from.

That gutta-percha evinces a greater degree of comparative improvement under great pressure is doubtless correct; but that is only a proof of its being a "worse insulator" than india-rubber. It is a more soft and yielding material, and hence "the nearer approach of the particles under the influence of external pressure interferes with their transmission of electrical motion," whatever Mr. Siemens may suppose to the contrary; for if it is to be "referred to the specific atomic arrangement of the material in question," then it is difficult to see how pressure can affect its electrification at all.

Notwithstanding the unjustifiable assumption of Mr. Siemens, and the utterly untrustworthy nature of the experiments he has placed upon record, the paper thus corrected will be productive of good if it results in further and more accurate investigations in this direction. It may be safely asserted that a good india-rubber core has never been submitted to this test; but it is very desirable that satisfactory experiments should be made in order to ascertain the real state of the case.

India-rubber cable manufacturers seem very desirous their material should be adopted, but they are somewhat remiss in making use of the means necessary for the accomplishment of that end. Every imaginable experiment has been made by the advocates of gutta-percha on that substance to show forth its good qualities; and, generally speaking, what experiments have been made on india-rubber have been by the same parties, and, of course, the result has been uniformly to the disadvantage of the latter. If the other party are in earnest, however, it is quite time they combatted their opponents on their own ground. Why not institute their own experiments, and demonstrate to the world that caoutchouc possesses all the essential qualities of a first-class insulator, instead of resting content with making bare assertions merely, and allowing such important matters as these to go undisputed.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

X.

A.D. 1845.—Dr. Remak, in 1845, discovered that certain points favourable for the application of electricity to the human body "corresponded with the points of entrance of the muscular nerves, and that the degree of contraction of a muscle was proportioned exactly to the number of motory nerve-fibres embraced by the current at its point of application." (See Dr. Remak's *Ueber Methodische Electrisirung gelähmter Muskeln*, Berlin, 1845; also, *The British and Foreign Medico-Chirurgical Review*, January, 1859, p. 91, *et seq.*)

A.D. 1846.—Dr. Pring, in 1946, submitted to the Royal Society his process of electro-disruptive etching. The hardest steel is thereby engraved by the disruptive discharges passing between a metal tool and the face of the plate. A galvanic series, in connection with an electro-magnetic coil, is used, the plate being attached to one pole and the tool to the other pole of the arrangement. (See Smee's *Electro-metallurgy*, pp. 337, 338.)

A.D. 1846.—M. Crusell, of St. Petersburg, in 1846, "conceived the idea of cutting and cauterizing the tissues, by means of a wire or a thin plate of platinum, rendered incandescent by a powerful electric current, by making them act after the fashion of a saw, by means of a backward and forward motion." (See De la Rive's *Treatise on Electricity*, Vol. III., p. 687.)

A.D. 1846.—Mr. Hearder, in 1846, constructed his electro-dynamic coil. By means of this apparatus, in connection with a galvanic battery and the condenser of M. Fizeau, sparks can be obtained through an intervening space of air without previous contact. (See Noad's *Manual of Electricity*, pp. 727, 728.)

A.D. 1847.—Professor William Thomson, in 1847, advanced his singularly beautiful theory of electrical images and reflections. (See *Encyclopædia Britannica*, 8th edition, art. Electricity, p. 534.)

A.D. 1847.—Professor Silliman, about the year 1847, successfully copied the iridescent colours of mother-of-pearl by the electro-type process. For this purpose a mould is taken of the shell in fusible

metal, and an electro-cast from that mould. (See Smee's *Electro-metallurgy*, pp. 281, 282; also Timb's *Year Book of Facts*, 1847.)

A.D. 1847.—Werner Siemens, in the summer of 1847, tried successfully a gutta-percha-covered copper wire on an electric telegraph line of from four to five English miles in length, viz., between Berlin and Gross-Beeren. (See *Journal of the Society of Arts*, April 23, 1858, p. 350.)

A.D. 1847.—Mr. E. Loomis, in a letter to Mr. Sabine, dated August 2, 1847, proposes to use Morse's "magnetic telegraph," to determine the difference of longitude between Philadelphia and Washington. (See Abbé Moigno's *Traité de Télégraphie Electrique*, pp. 124-126.)

A.D. 1847, 1848.—Charles V. Walker, F.R.S., in 1847 and 1848, proposed and adopted under-ground wire, insulated with gutta-percha, for electric telegraphs. (See Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 4.)

A.D. 1848.—M. Foucault, in 1848, constructed an electric light apparatus in which the luminous point remains fixed; to effect this, the carbons are moved by clock-work, which is liberated, by the armature of an electro-magnet included in the electric circuit, on the weakening of the electric current. M. Breton's apparatus is similar to M. Foucault's, but instead of springs for approximating the carbons, weights and counterpoises are used; there is also a ratchet wheel and click movement instead of a detent employed to maintain the separation of the electrodes. In Duboscq's apparatus the electrodes have a constant tendency to come into contact, the upper one by its weight, the lower by a spiral spring tending to unwind an endless screw; during the passage of the current the regulating electro-magnets lever armature gears into the endless screw, and prevents the approach of the electrodes by intervening mechanism, but on the weakening of the current the force of the spring preponderates, moves the lower electrode, and revolves a barrel carrying a cord connected with the upper electrode; a pulley of variable diameter, which transmits motion to the barrel, enables the comparative motion of the electrodes to be accurately adjusted, the luminous point thus remains fixed under all circumstances. (See De la Rive's *Treatise on Electricity*, Vol. II., pp. 326-328; also Vol. III., pp. 310-315.)

A.D. 1848.—Dr. Faraday, in 1848, showed that gutta-percha has powerful insulating properties. "When rubbed it shows 'negative' electricity." (See *London and Edinburgh Philosophical Magazine and Journal of Science*, Vol. XXXII., p. 165; also Gmelin's *Handbook of Chemistry*, Vol. I., p. 313.)

A.D. 1848.—Werner Siemens, in 1848, in the bay of Kiel, and in crossing the Rhine at Cologne and other rivers, successfully established subaqueous electric telegraph conductors. (See *Journal of the Society of Arts*, April 23, 1858, p. 351.)

A.D. 1848, 1849.—M. Dubois Reymond, in 1848 and 1849, published his researches in animal electricity. (See *British and Foreign Medico-Chirurgical Review*, January, 1854, p. 126.)

A.D. 1849.—Charles V. Walker, F.R.S., on January 10, 1849, made an experiment of submerging a gutta-percha-covered electric conductor in the open sea. "He attached two miles of insulated wire, submerged in the sea, to the end of one of the wires of the South-Eastern Company's" [telegraphic?] "system at Folkestone, and spoke through it to the Directors in London from the deck of the steamer." (See Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 4.)

A.D. 1894.—Werner Siemens, in 1849, observed the electric charge in underground telegraphic line wires. (See *Journal of the Society of Arts*, April 23, 1858, p. 358.)

A.D. 1849.—Baumgartner, in 1849, made observations which proved the existence of earth currents in telegraphic wires. (See Noad's *Manual of Electricity*, p. 239.)

A.D. 1849.—Mr. W. H. Walenn, in 1849, invented a single-fluid constant galvanic battery, composed of cast-iron, acid sulphate of iron, and prepared zinc. The zinc plate is coated with lead (from a solution of the acetate), and then amalgamated; or it may be immersed in a solution containing lead and mercury. (See *British Association Report* for the meeting in 1849, pp. 45, 46.)

A.D. 1850.—Messrs. Brett, in January, 1850, "projected and obtained concessions" for an electric telegraph line across the Channel. (See Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 4.)

A.D. 1850.—M. Froment's electric telegraph was invented in 1850. This apparatus writes or marks the despatch in conventional signs, by means of a style which cuts as it writes, because it turns round itself in the same time that it makes its to-and-fro movement. The style is moved in a direct manner by the armature of the electro-magnet, and can make from 3,000 to 4,000 vibrations per minute. (See Abbé Moigno's *Traité de Télégraphie Electrique*, p. 104.)

A.D. 1850.—Professor Page, of America, in 1850, described his electro-magnetic engine in a series of lectures which he delivered before the Smithsonian Institution. This arrangement consisted of electro-dynamic helices, which, by their alternate excitement, gave reciprocating motion to iron cores; a connecting rod and crank communicated this motion to a fly-wheel shaft, and thence to the work to be performed. (See Dodd's *Industrial Application of Electricity*, p. 10; also De la Rive's *Treatise on Electricity*, Vol. III., pp. 339, 340.)

A.D. 1851.—Ruhmkorff, in 1851, constructed his electro-dynamic coil. Grove and Gassiot subsequently made researches upon the passage of the electric spark developed by this apparatus in connection with Fizeau's condenser, and made to traverse various media. Poggendorff and Foucault constructed improved instruments of this kind. (See Noad's *Manual of Electricity* pp. 726-730; also De la Rive's *Treatise on Electricity*, Vol. II., pp. 23, 24, and Vol. III., pp. 722-729; also Poggendorff's *Annalen*, t. xciv., p. 289; also *Annales de Chimie et de Physique*, t. xliv., p. 375; also *Comptes Rendus de l'Académie des Sciences*, t. xlii., p. 215; also *Arch. des Sc. Phys. et Nat.*, t. xxxi. of the 4th series, p. 243; also *Comptes Rendus de l'Académie des Sciences*, t. xliii., p. 44.)

A.D. 1851.—Messrs. G. P. and R. F. Bond, of the Cambridge, United States, Observatory, in 1851, read an account of their apparatus for making astronomical observations by means of electro-magnetism to the British Association at Ipswich. This apparatus consists of an electric break-circuit clock, a galvanic battery, and a spring governor, by which uniform motion is given to the paper. The cylinder revolves once per minute, and the observer depresses a break-circuit key at the instant of the transit of a star over the wire or hair line of the telescope, thus making a record accordingly on the paper. This apparatus enables observations to be increased in number, and reduces the personal equation to the minimum. (See *British Association Report* for the meeting in 1851, pp. 21, 22.)

A.D. 1851.—Messrs. Brett, on September 25, 1851, laid an electric telegraph cable of massive construction across the Channel. (See Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 4.)

A.D. 1852.—Mr. Latimer Clark, in April, 1852, noticed the phenomenon of the slow transmission of electric currents through submerged wires. (See *Journal of the Society of Arts*, April 23, 1858, p. 356.)

A.D. 1853.—M. Boulu, from the year 1853, endeavoured to reduce tumours by causing electric excitation to penetrate into the substance itself of the tumours. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 683, 684.)

A.D. 1854.—Dr. Faraday communicated the results of his inquiries, respecting the Leyden jar charge of buried electric conducting wires, to the members of the Royal Institution, on January 20, 1854; he then showed that the electric currents which he employed travelled at the rate of only 750 miles per second along buried wires. (See Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 5.)

A.D. 1854.—Mr. Whitehouse, in 1854, commenced his researches on the possibility of working an Atlantic electric telegraph. (See Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 6.)

A.D. 1854.—Mr. Rutter, in 1854, invented a very delicate electroscope, that rendered the development of human electricity visible to the senses. (See *Encyclopædia Britannica*, 8th edition, art. Electricity, p. 572.)

A.D. 1854.—Dr. Boekel, of Strasburg, in 1854, made regular ozonometric observations in that city, and is thereby led to suppose that a connection exists between the presence of cholera and the diminution of the quantity of ozone in the atmosphere. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 700, 701.)

A.D. 1855.—Dr. Middeldorpff, of Breslau, in 1855, published a work on galvanism as a caustic. He uses three instruments, the "galvanic cautery," the "galvanic porte-ligature," and "galvanic setons." The galvanic cautery consists of a wooden handle, through which wires from the battery pass; the portion of the platinum rendered incandescent is rounded, and it can be turned to useful account when cold. "The galvanic porte-ligature consists of wires that are made to pass either in tubes of glass or of metal and good conducting tubes, but insulated from each other; the cutting handle is made to project beyond the extremity of the tube; the wires that pass through the tubes enables us to give to the terminal handle the volume and extent that are desired." Galvanic setons

consist of platinum wires that are guided through tissues when the object in view is to develope an inflammatory work. (See De la Rive's *Treatise on Electricity*, Vol. III., pp. 687-690.)

A.D. 1855.—Dr. Duchenne, of Boulogne, in 1855, pointed out the different degrees of the susceptibility of the various muscles under the same electric current; also methods of local electrization, by which either the skin or the subcutaneous tissues can be electrized. (See Dr. Duchenne's work *On Localized Electrization and its Application to Physiology, to Pathology, and to Therapeutics*, Paris, 1855; also De la Rive's *Treatise on Electricity*, Vol. III., pp. 611, 633, and 703.)

A.D. 1855.—M. Dubois Reymond, in 1855, gave some lectures on electro-physiology at the Royal Institution, in which the existence of the electric current developed by the action of the human muscles was proved. (See Noad's *Manual of Electricity*, p. 463.)

A.D. 1855.—Mr. Whitehouse, in 1855, showed the effect of oppositely charging a submarine electric telegraphic conductor in neutralizing the Leyden jar charge. (See *British Association Report* for the meeting in 1855; also *Practical Mechanics' Journal*, November, 1855, p. 185.; also Whitehouse's pamphlet, *The Atlantic Telegraph*, p. 7.)

A.D. 1856.—Dr. Andrews, in 1865, proved that ozone is an allotropic modification of oxygen. Ozone has the following remarkable properties:—1. It negatively polarizes metals that have only a weak affinity for oxygen. 2. It is a powerful oxydizing agent. 3. It bleaches vegetable colours. 4. It liberates iodine from a mixture of iodide of potassium and starch paste. (See *Philosophical Transactions*, 1857, pp. 1—13; also De la Rive's *Treatise on Electricity*, Vol. II., pp. 469, 480.)

A.D. 1856.—Professor Matteucci, in 1856, made note-worthy electro-physiological researches, the results of which were as follows:—"Living muscular tissue develops heat by the sole act of its contraction." "The electro-motive power of a cut muscle is independent of the size of its transverse section." "The electro-motive force of the muscle increases with its length." Mammifers have the greatest electro-motive force of muscles; fish and amphibia have the longest duration of this force after death. Any cause that influences muscles also influences their electro-motive force. An instantaneous electrical discharge takes place in a muscle during contraction. (See *Philosophical Transactions*, 1857, pp. 129-143.)

A.D. 1856.—Mr. Whitehouse, in 1856, described an electro-magnetic balance, which gave the "value" of an electric current, telegraphically speaking; he also proved that the "law of the squares" is not the law applicable to the transmission of signals in submarine circuits, but that it is "very little beyond the simple arithmetical ratio." (See *Athenæum*, August 30, 1856, p. 1092; also *British Association Report* for the meeting in 1856.)

A.D. 1857.—Dr. Ziemssen, in 1857, states that the electric conductability of the tissues of the human body is in direct proportion to the quantity of water they contain, also that the central organs of the nervous system, as well as nerve-branches in the large natural cavities of the body, escape the electric current on account of their envelopment in good conductors. With a powerful current, however, these organs may be reached. Dr. Ziemssen also states that electricity is of use in intestinal atony. In his work drawings are given of the position of the points by which to electrically effect the muscles through the agency of the nerves. (See Dr. Ziemssen's *Die Electricitat in der Medizin*, Berlin, 1857; also *The British and Foreign Medico-Chirurgical Review*, January, 1859, p. 91, *et seq.*)

A.D. 1858.—The Atlantic Telegraph Company, on August 5, 1858, received the first signals through 2,050 miles of the great Atlantic electric telegraph cable. This is the day on which the cable was first landed at Valentia. (See *Saturday Review*, August 21, 1858, p. 191.)

THE WORLD-GIRDLE TELEGRAPH.

The playful idea of "Puck" of putting a girdle round the world is rapidly becoming a sober, serious reality. The Governments of Russia and of North America discuss the subject from the most practical points of view—they have measured the distance, tested the climate, counted the cost, and estimated the advantages of such a telegraph, and, what is more, have resolved to give ample encouragement to its construction. We stated some months since that the Russian Government had given a concession to Mr. Collins, an American citizen, for laying a line through the Russian territories in North America up to Behring's Straits; that the British Government had granted facilities for making the line through British Columbia to the Pacific States of America, and that the United States Government had very strongly recommended the carrying out of the plan. In the Old World, Russia is extending its lines of telegraph through Siberia to the Pacific, and England and America stretch forth their hands from the Atlantic to grasp the world-uniting wires. The Hudson's Bay Company are also at work in the same direction, and already the wires and insulators necessary for the construction of a line entirely through British territory to the shores of the Pacific have arrived at the Red River, from whence this line of telegraph will commence its journey. This will give an alternative line entirely through British territory, as far as the boundary of Russian North America, where it will connect itself with the Russo-Anglo-American line.

A short time since Mr. Seward referred the scheme of Mr. Collins to the consideration of the Committee on Commerce in the Senate of the United States. We have been favoured with a copy of his very able State paper on the subject. In it Mr. Seward informs the committee that during all the time that Mr. Collins has been engaged in maturing and developing his scheme, and presenting it to the consideration of Russia and Great Britain, he has been acting under the instruction and with the approbation of the Department of State at Washington. Mr. Seward commences by saying that—

"Mr. Collins is an American citizen, residing in California. He has been, since 1856, commercial agent of this Government for the Amoor River. The public archives, as well as the records of Congress, furnish satisfactory evidence that the country could not have a more enlightened, assiduous, and faithful representative. The project which he submits for the consideration of Congress is the construction of a line of telegraph from some point on the Pacific Telegraph line, or the northern extension thereof, in one of the North-Western States or territories, across the border of the United States and through British Columbia and Russian America to Cape Prince of Wales; thence across Behring's Straits to East Cape, and thence by an inland route across the Sea of Okhotsk to the mouth of the Amoor River. The telegraph line thus proposed is intended, primarily, to connect at the last-named place with a line to be extended from thence to Irkoutsk, the capital of Eastern Siberia. At that important town a line of telegraph begins, which stretches through Tomsk and Omsk, in Western Siberia, Katherinburg on the Asiatic European frontier, Pirm, Kasan, Nijni-Novogorod, and Moscow, to St. Petersburg, the capital of the Russian empire. The line projected by Mr. Collins, from the Pacific Telegraph to Amoor River, with its anticipated extension by the Russian Government to Irkoutsk, would be the one link now wanted to supply direct and unbroken telegraph communication from Cape Race, in Newfoundland, on the eastern coast of America, across the eastern and western continents and the Pacific Ocean to Cape Clear, in Ireland, the westernmost projection of Europe. When a submarine cable shall be successfully laid between Cape Clear and Cape Race, it will, together with the link I have last before described, complete a telegraphic circuit around the earth between the parallels of forty-two degrees and sixty-five degrees of north latitude. Three questions arise from Mr. Collins's memorial, namely:—First—Is the enterprise feasible? Secondly—Would it be useful? Thirdly—Has it a just claim on the Government to the patronage which he solicits? The most prominent physical difficulty is the extent of territory to be traversed. The starting point must be chosen in either Nebraska, Kansas, Colorado, Utah, Montano, Idaho, Oregon, or Washington. Thence the distance to the line of British Columbia would be about 1,000 miles; the distance to be traversed through British America to the line of Russian America, about 600 miles; the distance through Russian America to Cape Prince of Wales, about 1,900 miles; the length of a submarine cable across Behring's Strait would be forty miles; and the distance from East Cape, by an inland passage around the Sea of Okhotsk, and through the settlements of Okhotsk, Ayan, and Shantar's Bay, which are well-known stations of the whale fishery, to the mouth of the Amoor River, would be about 2,500 miles. The entire length of the line would be about 6,040 miles. Operative telegraph wires have already been stretched on this continent of the aggregate length of 70,000 miles; and similar wires have been stretched, on the eastern continent, of the aggregate length of 200,000 miles. Operative submarine telegraph wires have been laid of the lengths, respectively, of 300 miles and 500 miles, from Dover to Heligoland, and from Malta to Tripoli. Thus it is seen that the mere extent of the route to be traversed in the present case, does not constitute an insurmountable, nor even a serious difficulty. The physical obstacle which next presents itself is the surface formation of the regions to be traversed. That portion of the route which lies within our own territory is chiefly mountainous; and the projected telegraph line must at least course along declivities of the mountains, even if it should not be found necessary, in one case, to surmount them. British Columbia presents a similar topography. But there the mountains are divided into three ranges, whose courses are from north to south, while intervening valleys invite the introduction of telegraphs and roads. The Pacific coast of Russian America is chiefly level. The portion of Siberia which lies between East Cape and the head of the Sea of Okhotsk is, for a large extent, a steppe, or plain, with gentle elevations occasionally rising into mountainous ridges. At the head of the Sea of Okhotsk a range of mountains must be crossed, and the region lying

between that range and the mouth of the Amoor River is of the same character as that before mentioned, which extends from the same range northward to East Cape. The highest elevation to be overcome on the whole line would be found on the Rocky Mountains, within the United States; and this elevation may be estimated at 8,000 to 10,000 feet. Operative telegraph lines have already been stretched over steppes, in both continents, similar to those thus described. The Pacific Telegraph line, in crossing the Sierra Nevada, rises to an elevation greater than that which is to be surmounted on the line now under examination. With the exception of timber, all the materials of a telegraph line are light and portable. Metallic wire sufficient for a mile of telegraph, together with the materials for insulation, weighs not more than 400 lbs. Sufficient timber awaits the builder along the route through the United States and British Columbia. Timber is also found on those portions of the projected line which lie within the Russian dominions, on each continent, with the exception of a timberless steppe, 500 miles wide, on each side of Behring's Strait. There the needful timber can be brought near to the line, either by sea or from the forest-covered shores of navigable rivers. The temperature of the region through which the northern part of the lines would pass is very low. Nevertheless, winter is less severe than it is between the same parallels of latitude on the Atlantic coast. The telegraphic line which connects St. Petersburg with Archangel on the White Sea, and also the telegraphic line which passes around the Gulf of Bothnia and connects St. Petersburg with Tornea, are maintained in operation without difficulty, although they cross as high parallels of latitude as those which lie in the way of Mr. Collins's line. The waters of Behring's Strait are about 180 feet deep, and they are frozen through one-half of the year; but the congealed mass, when broken, generally takes the form of anchor ice, and not that of icebergs. Thus, climate seems to offer no serious obstacle to the enterprise; while it is not entirely unworthy of consideration that in cold latitudes timber used in any necessary structure is less perishable than timber used in warm latitudes, while less of insulating material is demanded in high latitudes than is required in more genial climates.

"The only political difficulty in the way of the enterprise is the fact that it requires concerted aid from three several States, viz.—The United States, Great Britain, and Russia. The two last-named Powers have already, with enlightened and fraternal liberality towards the United States, made all the concessions which were demanded. Therefore, if Congress shall grant the application of Mr. Collins, no political obstacle will remain.

"The result of the survey of facts thus far made is, that there are no insuperable obstacles, either physical, political, or social, in the way of the projected line of telegraph.

"In regard to the expense which it requires, Mr. Collins estimates the whole cost at five millions of dollars. A just legislative caution would probably induce Congress to double that estimate. I understand that an association is already formed, with a capital of ten millions to be devoted to the enterprise. I am, therefore, of opinion that is is entirely feasible.

"As to the probable usefulness of the enterprise. It is quite too late at this day to debate the abstract question of the usefulness of the magnetic telegraph. It would be as easy now to dispense with the steam-engine on land or on sea, in the business of commerce, in social intercourse, or in political affairs, as it would be to forego the use of the telegraph. To be without it, is to be isolated. Other conditions being equal, the country that has the largest extension and the most thorough radiation of the telegraph wire enjoys the most active and profitable system of domestic commerce. Of the 70,000 miles of telegraph now in operation on the American continent, 60,000 miles are found within the United States, and the remainder in the provinces of British America. But commerce on the American continent defies political restraint and centralizes itself within our own country. For practical purposes, we may regard the whole telegraph system of the American continent as our own. But internal commerce imparts life to, and receives new life in return from foreign commerce. In proportion to the extent and variety of its resources, the nation that enjoys the most prosperous foreign commerce exhibits the greatest industrial activity and domestic happiness within its own borders. The vigour which commerce has already attained among us, while we continue to hold our communications with the eastern continent by navigation only, is justly a subject of national congratulation. Can there be a doubt that if our telegraph system should be connected by a trans-oceanic line with the one that is now performing its equally isolated part on the eastern continent, new and stronger reciprocity would be exhibited, not only in commercial centres, but in every recess of the land?

"Every one, knows, however, that neither the American nor the European system has yet attained to its ultimate development. Transient wars now delay the establishment of wires in Pensacola, Havana, San Juan, Panama, Quito, Lima, Valparaiso, Buenos Ayres, Monte Video, Rio Janeiro, Surinam, Caraccas, and Mexico, and the incorporating of them, with all their local ramifications, into one American telegraph system. On the eastern continent neither the domestic disturbances nor the rivalries of States, nor their occasional collisions, prevent a continual expansion of the telegraphic system. The telegraph construction of Russia at this day, like her system of railroads, presents the frame-work of an imposing structure, the dimensions of which are boldly outlined, while the connections and extensions yet remain imperfect and unfinished.

"When we take into consideration the fact that Russia has already brought all her chief inland markets and mines, as well as her principal ports on the coasts of the Arctic Ocean, into telegraphic communication with her capital, it is readily perceived that, by offering to co-operate with us in giving effect to Mr. Collins's design, Russia actually invites us to put forth our national energy from every point within our borders where industry of any kind dwells, and especially from our North Western and Western States, and apply that energy in the great work of renewing and restoring the long-languishing civilization of the regions where our race first impressed its dominion upon the globe appointed for its residence.

"It is important to remember that the telegraph wire is as yet a newly-invented instrument, timidly employed and clumsily handled, with a very imperfect knowledge of the fulness of the power that resides in it. It costs us now one-half a mill per mile to speak a single word through the cheapest telegraph wire of any considerable length. This is vastly more costly than the average transmission of messages in writing by employing the steam-engine, either on land or on water. This great expense of telegraphic communication is due, however, not at all to any inseparable quality of the telegraphic machine, for that machine is easily constructed of very simple and cheap materials. The expensiveness is due to two transient conditions of the telegraph system:—First, the charges now justly imposed upon it for rewarding the inventors; and, secondly, the fact that, as yet, fixed habits of communication in ancient forms prevent frequent resort to the new mode of correspondence, and customary investments of capital which are sufficiently remunerative cause it to be sparingly applied to the perfection of the new system. When these merely ephemeral embarrassments of the magnetic telegraph shall be removed, the magnetized wire will become, for the chief purposes of social, commercial, and political communication, as practical as, by reason of its adaptation, it is effective."

Mr. Seward concludes by saying:—"It seems to me that in extending dominion over inland mountain regions, and setting up the National flag on the Pacific coast, the American people, however inconsiderately, assumed the duty of diffusing an equal civilization throughout the whole of the great country which they thus included within their borders. Nor would it be wise to shut out from our thoughts the consideration which necessarily results from contemplating calmly the positions and the resources of our new North-Western and Western States. It becomes our duty to act upon the conviction that, from this time henceforth, those States are to perform an important part in a great work which shall make the shores of the Pacific Ocean the home of communities that shall be as busy, as prosperous, as free, as enlightened, as powerful, and as happy as those which now cluster upon the Atlantic shores. The Atlantic States, by their intermarriage with those of the Pacific, have come under an obligation to favour this great development. What Mr. Collins asks of Congress is, the grant of a right of way across the public lands, with the right to take therefrom materials necessary for constructing the line; the use of a national vessel, suitably officered and equipped, to make surveys and soundings along the North Pacific coast, beyond the limits of the United States, and to aid in prosecuting the work; and, finally, a stipulated compensation for the Government use of the line, when it shall be constructed. If the views I have submitted are just, this demand for patronage is neither unnecessary nor unreasonable. We could not withhold it without showing a want of appreciation of the liberality and friendship which have been manifested towards the United States, by Russia and Great Britain, in the proceedings they have adopted towards the same enterprise. I do not know any one object lying within the scope of our foreign relations more directly important than the preservation of peace and friendship with those two great and enlightened Powers. Nor can I conceive of any one measure of national policy that would more effectively tend to secure that great object than the construction of this proposed intercontinental telegraph. I forbear to urge the project in competition with the proposed line across the Atlantic from Cape Clear to Cape Race, which, notwithstanding past difficulties, I yet hope to see speedily completed. The two lines would naturally aid and strengthen each other. If they should even come into competition, it would be more advantageous to the world to have the use of both than the use of only one of them. One might be expected to operate when the other should be accidentally suspended. Nor can it be reasonably doubted that the great interests of human society will, at a very early period, require more than one, and more than even two, trans-oceanic, world-encircling telegraphs."

[The substance of the State record, from which our contemporary, the *Railway News*, quotes above, has previously appeared in these columns.—Ed. T. J.]

ANNUAL REPORT BY CHAS. TODD, Esq., SUPERINTENDENT OF TELEGRAPHS, &c., SOUTH AUSTRALIA, 1863.

(*Concluded from page* 166.)

Extract from the appendix relative to the proposed telegraphic communication between the Australian colonies and Java. Mr. Todd says:—

To refer, in the first instance, to Mr. Gisborne's scheme. It appears from his letters to Sir George F. Bowen that he and his co-promoters are prepared so far to meet the views of the colonies as to agree to terminate their cable at Van Diemen's Inlet, on the east side of Carpentaria, thus reducing the length of cable (from Cape Sedano, East Java) to 1,855 nautical miles, requiring a capital of £710,000 (increased in a subsequent letter to £725,000), for which a subsidy of £35,500 is asked on the same terms as before.

It will be remembered that the original scheme, which provided for the

cable being laid to Brisbane, was estimated at £1,100,000, with a subsidy of £50,000.

To the £725,000 we should, of course, have to add the cost of the land section from Van Diemen's Inlet to Brisbane.

In consenting to alter their plans, Mr. Gisborne goes on to say, "But as the English public are not in a position to judge of the feasibility of constructing within a specified time, or of afterwards efficiently maintaining, the proposed overland telegraph, the promoters will require the following conditions:—

"I. That the Government of Queensland shall construct and maintain an overland telegraph between Brisbane and Van Diemen's Inlet within one year and a half from the date of the contract, granting the subsidy for the cable between Java and the said Inlet.

"II. That for every day beyond the said one year and a half which shall elapse without telegraphic communication being completed, and after its completion for every day that such telegraphic communication shall be interrupted between Brisbane and Van Diemen's Inlet, the Government of Queensland engage to pay to the company at the rate of ten (10) per cent. per annum upon the cost of the said submarine line."

The foregoing conditions, it is observed, are only a counterpart of the similar condition which provides for the infliction of a penalty on the company whenever the submarine line may be interrupted. The 10 per cent. thus deducted from Queensland would go to pay the working expenses of the company.

On the two foregoing conditions I have only to remark that the time allowed for the land-line being erected, though perhaps ample, might, without disadvantage, be extended to two years; at all events, the payment of 10 per cent., required in the second condition, should not commence before the expiration of two years from the date of signing the contract: presuming, of course, the cable to be laid, and in efficient working order at that time.

The promoters, represented by Mr. Gisborne, are prepared to lay cables, of the kind specified in Messrs. Forde & Fleeming Jenkin's letter, from

	£	s.	d.
Rangoon to Singapore, at estimated cost of . . .	450,000	0	0
Singapore to Batavia " " . . .	170,000	0	0
Java to Gulf of Carpentaria " " . . .	725,000	0	0
Total estimated cost	£1,345,000	0	0

With regard to the first section, we learn that the Secretary of State for India cannot entertain the proposition until the Treasury is prepared to assist in its further extension to Australia, from which it may be inferred that this portion of the line of communication would be carried out simultaneously with the line to Australia; and the second section, from Singapore to Java, is dependent on the carrying out of the first, the Dutch Government having agreed to pay a subsidy of £8,500 for thirty years, subject to the completion of the line from Rangoon.

The third, or Australian section, it is proposed should be laid in the following manner:—

Cape Sedano to Coepang		590 knots
Coepang to Port Essington		525 "
Port Essington to Cumberland Straits		285 "
Cumberland Straits to Van Diemen's Inlet . . .		430 "
Total, direct		1,830 "
Slack cable, 5 per cent.	92 knots	275 "
Repairs, 10 per cent.	183 "	
Total cable provided		2,105 "
Of which, Main cable	1,855 knots	
Shore ends	250 "	
		2,105 "

The promoters now ask the Imperial Government to assist the undertaking by the payment of one-fifth of the subsidy; that promised, they would be prepared, they state, to at once register themselves as a company.

It was not, however, to be expected that the home authorities would give any promise of pecuniary aid to a scheme of this kind without reference to the colonies most interested, and who, in the event of its being finally carried out, would have to pay the greater part (four-fifths) of the cost; the matter has accordingly been remitted to the several Australian Governments with a view to joint action being taken, without which nothing can be done. There can be no doubt that the Imperial Government will be quite willing to contribute its fair quota when we have decided amongst ourselves as to the best plan to be pursued.

Should the Home Government consent to subsidize Mr. Gisborne's line, or, which would be the same thing, to provide one-fifth (1/5) of the capital, the subsidy might be apportioned somewhat as follows:—

Home Government	£7,100	0	0
Victoria	12,425	0	0
New South Wales	7,100	0	0
South Australia	3,550	0	0
Queensland	1,775	0	0
New Zealand and Tasmania	3,550	0	0
	£35,500	0	0

Allusion is made to the course pursued in South Australia with reference to the question under consideration; and it has been represented that this colony has advocated a line from Spencer's Gulf to the North Coast, from a selfish desire to promote her own immediate interests, without regard to its practicability or expediency. Such is not the case. The line across the interior has only received support because it would be the most direct, and therefore, since recent explorations have proved that no very great physical difficulties exist, the less costly.

As a great deal of misconception prevails on this point, which, by evoking a spirit of jealousy, cannot fail to operate more or less injuriously in the consideration of this important work, I feel it necessary to state most distinctly that this colony would derive no exclusive advantage; nor practically any priority of intelligence of commercial value, from its geographical position, should the line here proposed be adopted. Suppose, for instance, the communication to be viâ Adelaide, and thence by existing lines to the neighbouring colonies; practically, a message addressed from London to Melbourne would be delivered as soon as one simultaneously addressed to Adelaide. A merchant in Adelaide, simply because the line passed first through South Australia, would have no intelligence that would not be equally and as early accessible to a merchant in Melbourne. In a commercial point of view, therefore, we should obtain no advantage over other colonies by Stuart's route being followed.

The misconception I have referred to arises from persons, ignorant of the actual working of the telegraph, supposing that we should in some way be the first to receive valuable information, of which, if we pleased, we could take advantage before it could reach Melbourne and Sydney. In fact, I have heard persons say, in dilating on its importance to us, that we could sell the news. A similar notion was recently held with regard to "mail news," whereas Melbourne being the larger place, it would not unfrequently happen, as it does now when the mail comes in, that "foreign telegraphic intelligence" would be received from Melbourne which had previously traversed the whole length of South Australia. I have adverted to this because of its obvious mischievous tendencies.

The real question to be considered is that of cost. The colonies are mutually interested in securing the most serviceable and least costly route—that which offers the greatest advantage at the least expense, whether it be that now proposed by Mr. Gisborne or any other. It is not a question which colony will be most benefited, but which line will be the best and cheapest.

On the one hand the promoters, as such, would naturally prefer as great a length of cable as they can get us to agree to, upon which they would derive the more profit in its manufacture, and the larger subsidy in its after working. On the other hand, the colonies are interested in reducing the cost to a minimum, consistent with the success of the enterprise, and will consequently desire to push forward their land-lines, which will besides facilitate the opening up, and settlement of, the country—a consideration which cannot be viewed with indifference. Mr. Gisborne is incorrect in saying that, in advocating a land-line, neither South Australia nor Queensland contemplate sparing any outlay on the part of the other contributing colonies; since it is quite clear that, by shortening the sea line and thus reducing the cost and consequently the annual subsidy, the amounts contributed by each colony will be proportionately diminished.

I now come to Mr. Walters's correspondence, which, although extremely valuable, need not detain me long, inasmuch as the important suggestions he offers, and the information he has gathered, are in the main coincident with the views I have all along expressed. Mr. Walters is evidently unaware of this, and his recommendations are invested, therefore, with the greater force, being based on altogether independent sources of information, and yet confirming and supporting the course I have throughout advocated.

The purport of the correspondence furnished by Mr. Walters may be summarized as follows:—1. The plans of Mr. Gisborne and his co-promoters are unnecessarily costly, cheaper routes being available. 2. The saving to be effected by, and for other reasons the advisability of, the Governments dealing directly with the manufacturers of the cable, instead of with the promoters. 3. The desirability of appointing one consulting engineer and electrician, who should alone be held responsible, instead of a board with divided responsibility. 4. To submit Mr. Passmore's offer to construct and lay a cable from East Java viâ Timor to the north coast of Australia, and to erect from thence 1,100 miles of land-line. 5. Sundry valuable hints as to the mode of procedure in the construction of the line and after working it.

With regard to the first, Mr. Walters has rendered important service in bringing so prominently before his Grace the Duke of Newcastle the great saving to be effected by the erection of a land-line over a great portion of the distance, a course which our better knowledge of the interior had shown to be perfectly practicable.

The cost of the modified scheme put forth by the promoters is, as we have seen, £725,000, to which must be added the cost of the land-line to Rockhampton, estimated by the late Mr. J. J. Austen at £120,000; or, putting the latter at £100,000, the cost of the whole would be £825,000.

The cost of the line from Port Augusta to Cambridge Gulf, and thence viâ Timor to East Java, I have before estimated at £403,200. If the cable is landed at the Adelaide River we shall increase the distance; but we may safely set it down at £450,000.

A line from Rockhampton to the Adelaide River, and by cable to East Java, would be about the same. In either case we have a saving of something like £375,000.

As mentioned in my last annual report, Mr. Cracknell, the superintendent of telegraphs in New South Wales, has recommended the last route; the first portion from Peak Downs to, say, 138° east longitude, to be erected at the joint cost of New South Wales and Queensland; to be continued thence by South Australia through her newly-acquired northern territory, to some suitable point on the coast, which would give 1,000 miles (reckoning from Port Curtis) to be constructed by the two former colonies, and 600 by South Australia. Should we decline to carry it on, Mr. Cracknell proposes to terminate the line at the Albert River, which would practically fit in with Mr. Gisborne's project.

It will, perhaps, induce greater confidence in my figures to find them so closely in accordance with the independent estimate made by Mr. W. B. Passmore, of London, a gentleman of considerable experience, who, in a letter addressed to the Agent-General (14th March, 1863), estimates the cost as follows:—

Submarine cable from East Java to Timor, and thence to nearest landing-place on the north coast of Australia . . . 940 knots.

	£	s.	d.
940 knots at £250	237,000	0	0
Land section, say 1,100 miles from coast to some central point	175,000	0	0
	£412,000	0	0

In a letter to the Right Hon. the Chancellor of the Exchequer (24th March, 1863) he undertakes to construct and lay a cable from East Java to the north coast of Australia, and from thence a land-line to any point in the interior, not exceeding 1,100 miles, for the sum of £412,000. This offer Mr. Passmore is still prepared to stand by, and is waiting the decision of the Colonial Governments.

I may, moreover, add that my estimate for both the submarine and land sections has been supported by Mr. Cracknell and the late Mr. J. J. Austen. It is satisfactory also to find that the views I have so frequently expressed as to the feasibility and superiority of a land-line are so strongly supported by Mr. Cromwell Varley. In his letter to the Agent-General of the 17th March, 1863, he observes:—"1st. The first cost of a land-line is very much less. 2nd. The maintenance is much more facile and inexpensive. 3rd. The lines being comparatively free from the effects of induction, are manipulated with greater ease and expedition, and fewer errors creep into the despatches during transmission in consequence. 4th. The various sections of land-line can be united together by translating instruments, so as to afford direct communication over distances of even 2,000 and 3,000 miles at a good commercial speed. We often work from London to St. Petersburg direct at a rate of eight to twelve words a minute. 5th. Submarine circuits, owing to the retarding action of induction, cannot be so united without too great a loss of speed, unless the core of the cable be extravagantly large."

In reply to the objections raised against the lines being carried across a comparatively wild country, he points to the recently-constructed line between New York and San Francisco, a distance embracing more than three hours of longitude, "which line of telegraph is entirely overground, and crosses the snow-covered Sierra Nevada and Rocky Mountains, passing through deserts and over 1,500 miles of country inhabited by savage tribes; the stations are from 30 to 75 miles apart." This line has been in operation for the last two years with scarcely any interruption.

There is no reason why the Governments should not contract for the cable direct with the manufacturer, and thus save the profit that would otherwise go into the pockets of the promoters. In any case, I am strongly of opinion that the manufacturer should be made responsible for laying the cable, and for its efficiency during the first year of its working. That would make his interest identical with that of the Government in producing the very best article possible with our existing knowledge.

The design of the cable should be as much as possible left to the manufacturer; but previously submitted for the approval of the consulting electricians.

After the form of cable has been decided on, the duty of supervision and testing during its manufacture had better be left to one electrician appointed by the Government; and there is no one whom I could recommend more confidently than the gentleman named by the Agent-General—viz., Mr. Cromwell Varley. By adopting the course I have suggested we should avoid what has been one of the most fruitful sources of failure in these undertakings—divided responsibility. The chief safeguard, however, would be to make the manufacturer responsible for the cable for one year after being laid.

In Mr. Fortescue's letter to the Agent-General of the 9th July, his Grace the Duke of Newcastle suggests, at the instance of the Lords Commissioners of the Treasury, that the several colonies should appoint representatives to meet for the purpose of discussing the question in all its bearings.

The Agent-General, in several instances, urges the same course, and it must be manifest, as I have repeatedly stated, that no progress can be made without co-operation among the colonies; and, as the best means of securing that, I would respectfully suggest that a communication should be addressed to the other Governments, advising a meeting at Melbourne of the superintendents of telegraphs in Victoria, New South Wales, Queensland, and South Australia, during the present summer. And I would submit the following suggestions for the consideration of the Government:—1st. That it is important to have as little cable and as much land-line as is practicable. 2nd. That the Government should deal directly with the manufacturer in procuring the cable. 3rd. That it would be unwise to invite tenders for the cable, but that the market price should be charged for the materials with an allowance to be determined for profit, offers being obtained from two or more manufacturers. 4th. That a board should be appointed in London, at which each colony and the Home Government should be represented, assisted by competent advisers in selecting the best form of cable, &c. 5th. That at least one paid consulting electrician and engineer should be appointed to watch the cable during every stage of its progress. 6th. That the manufacturer should design and furnish samples of the cable to be supplied. 7th. That the manufacturer should be held responsible for the proper shipment and laying of the cable, and further be responsible for its integrity and efficient working order for one year after the whole shall have been laid. 8th. That the land-line be erected by contract, under the superintendence of the Governments through whose province it may pass. 9th. That on the completion of the line the whole, or at least the submarine section, should, if possible, be leased. If the maker of the cable will farm it, as has been done in the case of the Malta and Alexandria cable by Messrs. Glass, Elliot, & Co., so much the better. If the line is leased proper provision must be made for renewal, a fund being set apart annually for that purpose. 10th. That the line should be constructed at the joint cost of the Home Government and the several colonies: the former contributing, say, one-fifth (⅕th), and the latter four-fifths (⅘ths), to be equitably apportioned on the basis of population, or the existing ocean postal subsidy. Or should the line, or any portion of it, be subsidized, then a similar division of such subsidy.

I would add, in conclusion, that although it is desirable, for obvious reasons, for an early conference to be held, no further steps towards the actual construction of the line ought to be taken until we have had at least six months' experience of the working of the Persian Gulf cable.

Mr. Passmore's offer would, of course, be considered in conjunction with Mr. Gisborne's at the proposed conference.—I have the honour, &c.,

CHARLES TODD,
Observer and Superintendent of Telegraphs, South Australia.

The Hon. the Commissioner of Public Works.

CORRESPONDENCE.

MR. BRITTAN'S PLAN OF COMMUNICATION BETWEEN GUARDS AND DRIVERS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—A whistle on the roof of the guard's van, worked by air compressed by the wheels of the carriage, was tried some ten years since on the Lancashire and Yorkshire Railway, if I am not mistaken. Would it not be undesirable to *weaken the significance* of the engine whistle by using it for any other purpose than that for which it is now employed?—Yours,

Bristol, 4th October, 1864. R. S. CULLEY.

MR. PREECE'S ELECTRIC SEMAPHORE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Will you kindly give a description of Preece's electric semaphore, referred to in your remarks on Colonel Yolland's report on the Sowerby-bridge accident in your last number, or say where any can be seen in actual working, as all the electric signals I have yet seen (if in connection with a semaphore or disc) have been useless, and could not be depended upon for one day. Even the use of such a signal would not, as stated in the last paragraph of your article, "dispense with the use of the hut, the man, the semaphore, and the distant signal," as the man being there to protect the tunnel by means of double-needle instruments on the "block" system, it is only policy to give him a semaphore and distant signal to work.—Yours obediently, ARCHIMEDES.

Manchester, 3rd October, 1864.

THE ORAN AND CARTHAGENA TELEGRAPH CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—You would oblige me, and very likely satisfy a great number of your readers, by giving news of the Oran and Carthagena cable. The news received in Paris from Algeria prove by their date that they come by post, and not by telegraph; so there is no doubt that the cable has been broken; but no official information of the accident has been already given. Very likely the English newspapers will first give notice of the failure, because the French Government having some interest engaged in the question, the French will only speak of it after the *Moniteur.*—Yours sincerely, UN ABONNÉ.

Paris, 1st October, 1864.

[We should have been exceedingly glad if we were able to furnish our esteemed correspondent with the information he requires about the Oran and Carthagena cable; but unfortunately we also on this side of the Channel are kept in oblivion with respect to the vicissitudes of submarine telegraphic lines. Government officials and contractors have combined together to set at naught the right of the public to be informed of the state of its property. We shall, however, endeavour to ascertain the present state of the cable in question.—ED. *T. J.*]

TELEGRAPHY AT THE BRITISH ASSOCIATION.—MR. J. B. THOMPSON'S INDUCTION MACHINE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—There is a criticism put forth this week in your journal on the "electrical science and its attendant submarine telegraphic science"—by the way, I should say telegraphy was Art, as represented at the meeting of the British Association at Bath. Now, on all occasions discussion is good if it be entered into with fair and honest intentions; for though the critic may not be equal to the task he has assumed, or he may misunderstand the matter in hand or the statements criticised, yet he will be willing to be put right on these matters, if he have no other object than just the truth of the matter.

In the present case "Amicus," apparently honestly, sets things down just as they appear to him, though somewhat hastily, before having thoroughly understood the subject or the statement of it. Of course I speak only of that portion of the critique which is devoted to my sayings and doings.

Before beginning with me "Amicus" prays to the Fates to keep him from getting out of his depth. Well, I do not think that he need to do that, if he had considered the thing a little before rushing into it. As it is, he flounders about and muddles the matter, and then pretends that he is afraid of getting out of his depth because he cannot see the bottom. It is possible that this may be a pretence, and that he huddled all these absurdities together so that he might appear funny; but "Amicus" should not forget that scientific matters are not discussed in that way. Scientific men are in the habit of first stating fairly that which they would criticise; then, with sound reason, they support their view of the matter; and after fair discussion, if the opposite be found to be absurd, then "let him laugh who wins." After all, it may be all done in good faith, and this is the very best that he can make of it. In that case, I am only too happy to be able to assist him.

First, he seems not to know exactly what theoretic views I would wish to put forth for discussion; he seems to take it that I am trying for the first time to show that electricity is not matter but energy: that is too great an honour for me to claim. I will refer him to Drs. Joule, Scoresby, and Faraday for that. He says that my "theory remorselessly overturns the prevailing ideas of light and heat, and necessarily of electricity and magnetism also." Now this is an error on our *friend's* part—one of ignorance, I presume, from what he says of light and heat. He says that I consider the "indulating" theory of light as old-fashioned. I did not know that there ever was a theory that did indulate, and if there had been such a theory, the sooner it was old-fashioned the better—such a shaky affair, you know. If "our learned friend" means the undulatory theory, then what is he dreaming about? If he knows anything about the matter in discussion, he ought to know that this theory is the solid ground from which I take my departure in my reasonings on the excitation of electricity and magnetism; whether I reason rightly or wrongly is another matter, and remains for discussion.

I take it for true that it is established that sound is by the indulations of the air, light of the æther, and heat of the ultimate particles of all matter; this last has been clearly set forth by Professor Tyndal. If our friend finds fault with me for considering heat, light, electricity, and magnetism as different forms of force, I cannot help it. I must continue to do so till he shows me a reason for altering. In the meantime, he can go on charging his wire with the two electric fluids, if he so please, without any interference of mine.

And now I will state what my theoretic notions on electric induction are, and wherein I conceive they differ from the notions hitherto held on that subject. First, it is believed that, in producing electric induction by means of an electro-magnet, it is the voltaic electricity used which produces the induction immediately, and not mediately; for it is said that all you can do by induction is to turn quantity into intensity. If it were as supposed, then the conclusion would be correct, according to the law of conservation of forces, and at first sight it looks as if it were so; but there are facts in induction which appear not explainable by it. The phenomenon of electricity undoubtedly exhibits a species of motion, whether you consider it a motion in the ultimate particles of the conductor or that there is some fluid flowing through it; whichever way it is, then, it is the motion that is induced. It follows, then, if the electricity of the battery by its fluxion produces the flow of induced electricity, that while the battery electricity continues to flow the induced electricity must also continue to flow, for while a cause continues to act the effect must continue to appear.

But it is well known not to be so; it is only on the instant of completing the battery circuit that the induced electricity appears, and it does not continue while the battery current flows, but again appears when the battery current ceases. It is clear, then, that the battery current as such does not produce the induced current, because for one battery impulse we have two induction impulses, and that in opposite directions, and not one continuous current while the battery current flows. We must look further, then, for the cause of induction; and the only other noticeable phenomenon connected with it is magnetism. It is proved that wherever there is an electric current there is magnetic excitation, whose polarity is at right angles to the current of electricity. A spiral current of electricity produces a sphere of magnetism; but this expression seems to offend our friend. I dare say he has strewed iron filings on a piece of cardboard and held it over a magnet, and has observed the filings arrange themselves into a series of regular curves. That which causes the filings to assume that form I call a magnetic sphere. Now this sphere has no motion but on its projection and recession. This also can be proved to any one. Take an electro-magnet, and place it with one or both poles upward, and over these poles place a card with iron filings upon it. Then, on making battery contact, the filings will rise up at right angles to the current, and on breaking contact they will fall down into their former position, and this as often as contact is made and broken; but between making and breaking contact there is no motion in the magnetic sphere; yet all this time there is a continuous motion in the electric current. This also can be shown by placing a voltameter in the circuit. I think these simple experiments clearly prove that it is not the flow of the voltaic electricity which produces the induction. The flow of the induced electricity does not coincide with the flow of the voltaic electricity, neither as to direction nor time; but it does agree with the projection and recession of the magnetic sphere, both as to direction and time; therefore, it appears to me that it is a warrantable conclusion to draw, that it is the motion of this magnetic sphere which produces the electric induction. This can be further confirmed by mechanically projecting a magnetic sphere across a spiral coil of insulated wire. Pass a magnet within such a spiral coil, and of course you will project the magnetic sphere across the spirals with the magnet, and also you will produce a current of induced electricity, and on withdrawing the magnet another, but in an opposite direction.

These are two or three facts out of very many which any one who understands the matter might adduce in support of this theory of electric induction. Very likely our present friend, or some other, will say, what odds whether the induction is produced by the voltaic electricity or by the magnetism which it excites? Great odds, my friends. It is then no longer a grinding of quantity into intensity. The voltaic electricity then simply prepares a way for the influx of the earth magnetism. And if it be an axiom in mechanics that action and reaction are equal, then it is practically of the utmost importance; for each of the induced currents of electricity should be equal to the one current of voltaic electricity. The magnetic force should be equal to the cause which excites it, and the induced electricity should be equal to the motion of the magnetic sphere which produced it; therefore, it should be equal to the voltaic electricity which excited the magnetism.

Now, according to the axiom the reaction of the magnetism will produce another induced current equal to that produced on its projection, and for this there is no expenditure of electricity; therefore, by electro-magnetic induction the electro-motive force is multiplied. So much for the theory; experiment only can confirm or disprove it. As to its practical application in the machine I need not say much, for everything that our friend says on that proves that he has not seen it, consequently cannot understand it, and certainly does not. It is not like a Rhumkorf at all, any further than this, that it has spirals of copper wire in it; yet these are not the same as in a Rhumkorf, and in every other respect it is perfectly different. It is not strained to produce its effect at all. It is governed by precisely the same laws as batteries for moderate tensions, and for high tensions it gives much more quantity than a battery of equal tension would do, and can be applied to every purpose for which a battery is used.

I should be glad that any one who wishes to criticise it should do so on inspection and examination, and not on mere surmise; they are heartily welcome. I wish it to be tried and proved, and rejected if found wanting.

J. BARNES THOMPSON.

3, Rothwell-street, Regent's-park-road, N.W.,
4th October, 1864.

TELEGRAPHIC NEWS.

TELEGRAPHY IN THE HOLY LAND.—London is now in communication with Sidon and Jerusalem by the electric telegraph.

ATLANTIC TELEGRAPH COMPANY.—Her Majesty's sailing frigate, Amethyst, 26, attached to the reserve at Chatham, which has been lent by the Admiralty to the Atlantic Telegraph Company to receive on board the Atlantic telegraph cable, for conveyance to the Great Eastern steamship in the Medway, left Chatham harbour, early on the 5th inst., in tow of a private steamer, and without an Admiralty pilot, for the works of the company at Greenwich. There the first portion of the cable will be shipped, and conveyed to the Great Eastern. The consequence of allowing one of Her Majesty's ships to leave Chatham without the customary Queen's pilot on board, was that soon after the vessel had got clear of the harbour those in charge of her ran her ashore on one of the numerous shoals at Gillingham Reach, at the entrance to the harbour. No one in charge seemed to be aware of the intricacies of the navigation of the river at the spot, although these are perfectly familiar to the duly authorised Government pilots accustomed to the navigation of ships of war to and from Chatham. All attempts to tug the vessel off the bank on which she had grounded proved fruitless, and with a strong ebb tide under her bottom she soon settled down, straining herself, it is believed, very severely. At flood tide in the evening she was floated off, but the extent of the injury she has sustained, which it is hoped is not serious, cannot be fully ascertained until the frigate shall have been docked. The explanation given by the dockyard officials is, that the vessel, having been handed over for temporary use to the Telegraph Company, they had virtually no further control over her subsequent movements.—[The first disaster!—ED. *T. J.*]

The Overland Telegraph to America.—The royal mail steamer Scotia arrived at Liverpool on Saturday morning, the 1st instant, at 1.30. Among her passengers were Mr. Hiram Sibley, president of the Western Union Telegraph of America, and Mr. P. M'D. Collins, projector of the overland telegraph to America, viâ Behring's Straits, who are *en route* to St. Petersburg to carry out the enterprise. From later advices we learn that the Western Union Telegraph Company, who, in connection with the Russian Government, have this great enterprise in hand, are actively engaged in fitting out an expedition under the immediate supervision of Captain C. S. Bulkeley, of the United States army, for Oregon, the coast of Russian America, and the country lying beyond Behring's Straits, to survey the route of the telegraph line, and make all other needful arrangements for putting the whole extent of the line under contract the ensuing year, and we understand that the projectors of the enterprise are sanguine that the line will be in successful operation between New York, San Francisco, St. Petersburg, and London about the middle of 1866.

The Persian Gulf Telegraphic Cable.—From Cornhill to Calcutta by electric telegraph appears to be not far from realisation. The financial and commercial world will be gratified to learn that, according to advices from the East, there is every probability that the Persian Gulf telegraphic cable has by this time been placed in working order. At the last accounts, the rupture discovered to have taken place in shallow water was being promptly remedied. For the present, the intention of carrying a land-line from Bagdad to the Gulf, over exclusively Turkish territory, must be abandoned, owing to the absence of control on the part of the Turkish Pashalic Government over the wild tribes that inhabit it. The more circuitous Turco-Persian route would be available at the present moment but for the malaria during the season of the swampy lands bordering on the Tigris, and the accustomed display of Persian perversity in placing obstacles to a mutual arrangement for right of way over a small section of territory, the ownership of which it disputes with Turkey. This section could be run in a few days. Russian diplomacy, which has so long sought to frustrate our efforts in the East, is perhaps at the bottom of the difficulty—a difficulty, however, which is not insuperable, and which, owing to the conciliatory tone adopted by the Turkish Government, we may hope to see shortly removed. We cannot afford to have our communications with the East interrupted either by Persian perversity or Russian duplicity.—*Money Market Review.*

Gutta-percha.—The imports of this article have considerably increased this year, owing, doubtless, to the large consumption for submarine telegraphic cables in course of manufacture. Thus, in the eight months ending 31st August they amounted to 15,139 cwt., against 8,404 cwt. in the corresponding period of 1863, and 9,531 cwt. in the corresponding period of 1862. In August alone the imports were 3,444 cwt., against 750 cwt. in August, 1863, and 1,924 cwt. in August, 1862. In 1863 the total imports of this article were 21,655 cwt.; in 1862, 48,284 cwt.; in 1861, 19,749 cwt.; in 1860, 21,821 cwt.; in 1859, 18,598 cwt.; in 1858, 19,641 cwt.; in 1857, 17,420 cwt.; in 1856, 15,557 cwt.; in 1855, 28,585 cwt.; and in 1854, 24,606 cwt.

The First Railway Train into the City of London.—On the 6th inst. several of the directors of the London, Chatham, and Dover Railway, consisting of Lord Harris, deputy-chairman, Sir Cusack Roney, and Mr. Cobby, accompanied by Mr. Forbes, general manager, Messrs. Cubitt and Turner, the engineers of the company, Sir Morton Peto, and Messrs. Betts and Crampton, the contractors for the works, and other gentlemen, crossed over the bridge of the company for the first time, in a train from the Blackfriars Station to the intended new Ludgate Station. The bridge, as well as the engine, was gaily decorated with flags, and the numerous workmen engaged in the operations of the company cheered the train very heartily during its progress. It may be mentioned that this is the first railway train that has entered the City of London, for although the Farringdon Station of the Metropolitan Railway and the Fenchurch Station of the Blackwall line are the City termini of these companies, they are both situated outside the precints of the City proper. The train passed smoothly and easily along the line, and proceeded from the southern to the northern end of the bridge. The bridge consists of four lines of railway, but it was upon those of the western side that the train ran upon this occasion, the filling in of the other lines not being so far advanced. Messrs. Kennard Brothers, of Crumlin Iron Works, near Newport, Monmouthshire, were the contractors for the superstructure, and Mr. Friend French, the practical engineer over the whole of the works. A new feature in this bridge, when altogether finished, will be that, along the top of the cross, elliptical braces on both lines of railway, 20 lines of telegraphic wire on each side will be fixed, making 40 in the width of the 56 feet; thus making a kind of curve over-head, which will have a very pretty and unique appearance. The examination throughout was deemed perfectly satisfactory. It is expected that the Ludgate-hill Station of the London, Chatham, and Dover Company will be opened for traffic to the public the latter end of next month.

South Australian Telegraphs.—We quote the following from the *South Australian Register*:—Mr. Todd states in his annual report, which has recently been laid before Parliament, that there is little probability of any steps being taken for the realisation of the proposal to establish telegraphic communication between Australia and England until the Indian line has been completed and thoroughly tested, for it would be altogether premature to enter into arrangements at this end of the Anglo-Australian line before the other end was in working order. Since Mr. Todd's report was written, however, suggestions have been laid before the authorities by a gentlemen of much experience who is now in Adelaide, relative to the advisability of establishing an overland telegraph between this colony and the northern settlement, with the view of bringing the several Australian communities nearer to the main postal route of India, China, and Europe. The idea is that a company should be formed for this purpose, and that, in addition to the opening of telegraphic communication with Van Diemen's Gulf, they should establish a line of small but fast steamers, one of which should leave Singapore for North Australia immediately after the arrival of each mail steamer from Suez, whether British or French. The preliminary operations of such a company, it is stated, would consist in establishing stations at distances of from twenty-five to fifty miles along the route explored by Mr. Stuart, which stations would be used for the purposes of the telegraph line and also for the maintenance of a horse post, which it is thought might be at first used for the transmission of mails. "By this arrangement," it is said, "regular postal communication would be established three times a month with Singapore, one of the chief ports and depots of the great steam line from Suez to China and Japan, and whence independent lines diverge to all the important European settlements on the Asiatic coasts and islands, namely—two to Bombay, three to Calcutta (one of which touches at the intermediate ports on the east side of Bengal), one to Siam, one to Cochin-China, five to China, one to Borneo, and two to Batavia, one of which continues the communication to all the Dutch ports of the Indian Archipelago." By the establishment, then, of an overland line of communication with steamers at the other end, all these ports and country would be brought into direct communication with the Australian colonies. It is stated that with a horse-post to North Australia, and steamers from Van Dieman's Gulf to Singapore, the transit would be sixteen and a-half days—the overland route from Adelaide being 1,400 miles, and the sea voyage 1,860 miles. These sixteen and a-half days added to the time which it would take to convey the mails from Point de Galle to Singapore would make about twenty-two or twenty-three days, or rather more than the time occupied by the Peninsular and Oriental steamer, via King George's Sound. There would, therefore, appear to be no advantage offered by the proposed communication overland as regards time, whilst the bulk of the mails would still have to be conveyed by sea. But, it is said, "the continuation of the European telegraph line to Singapore, which the Home Government are pledged to carry out as soon as the line is completed, would admit of six or seven days' later news being sent by post overland than can be obtained by the steamer which sails from Ceylon; and as it would be desirable to commence the North Australian line at the Adelaide end, each section as completed would be available for the transmission of intelligence; so that the new enterprise would compete successfully with the old route from the very first." It is, however, chiefly with regard to the operations of the telegraphic line when completed that the attention of the Australian colonies is called to this project. The following suggestions as to the capital which a company would require are extracted from the memorandum which we have referred to:—"The cost of the telegraph line will be £138 per mile, or £193,200 for the whole. Three steamers, which need not be of greater burden than 100 tons each, will suffice to keep up the communication with Singapore, but a fourth may be needed in case of accident. The cost of these will be about £5,000 each, or £20,000 in all. The cost of forming stations is included in the estimate for the telegraph line. The cost of a set of horses and gear will be about £2,500; bullocks and drays about £1,000. The annual expenditure in wages, coals, stores, &c., need not be estimated at present, but it may reasonably be calculated that telegraph fees and a subsidy from Government, in lieu of postage fees, will not only cover all this, but leave a large surplus. The cordial support of the general public, not only of this province but of the colonies generally, may be looked for with confidence. Certainly Victoria will approve of it, and probably New South Wales also. But this colony will be most benefited. The whole expenditure, with the exception of a portion of the outlay on steamers, will be disbursed within the limits of the province, and the impulse thus given to colonial enterprise must be felt by every member of the community. Under these circumstances a guarantee of say 5 per cent. on the paid-up capital is not likely to be withheld. The capital should be not less than £250,000; the Government guarantee on this would be £12,500 per annum. The monthly steamer to King George's Sound costs nearly £17,000 per annum at the present time." We do not understand, however, that this overland communication could for a great length of time be used as a safe substitute for the mail service by way of King George's Sound. It might supplement that service in a valuable manner, and also by means of telegraph wires insure the Australian colonies later news than can be obtained by steamers. This alone is a matter of undoubted importance, and deserves the consideration of all the colonists. Our readers may feel, perhaps, that the time is hardly come for entering upon such an enterprise. Nevertheless, the facts set forth are full of interest, and cannot be otherwise than useful, as they have been arrived at after careful inquiry as well as long experience in North Australia and the adjacent countries. We published a few days since a letter from Dr. Embling, of Victoria, relative to the practicability of establishing a regular overland communication between North Australia and South Australia. This gentleman has seen some reference in the public papers to suggestions which have been made in this colony on the subject of postal and telegraphic communication with the opposite side of the continent, and has taken the opportunity to express the strong opinions which he has been long known to entertain in favour of such a work, as well as to recommend that, in the

event of any steps being taken for this purpose, the Government of Victoria should be applied to for their co-operation and assistance. Dr. Embling states that some of the camels which were imported for the use of the unfortunate Victorian expedition, and which did their work well, are now located on the Wimmera; and he advises that whenever they are wanted they should be obtained, and be used either in establishing an overland postal communication, or in assisting to construct a line of telegraph between these colonies and the opposite coast. It is probable that the public mind will have to be prepared by a great deal of discussion on this subject before the work of constructing tramways and telegraphs through the centre of Australia is really entered upon. The distance is so great, the difficulties of the overland route are said to be so considerable, and the experiment of colonizing the opposite coast is so much in its infancy, that most persons will regard the question of tramways and telegraphs as one that at present can only be talked about. But even supposing the objections to be so great as they have been represented to be, it is still desirable that this matter should be discussed as early and as fully as possible. We all know by experience how often the extreme views of to-day become the practical realization of to-morrow; and in reference to the present subject, we feel certain that population alone is required to make it absolutely necessary that the northern and the southern coasts of this continent should be connected by complete and effective means of communication. A telegraph through the centre of Australia would be but a trifling work compared to the vast lines which have been established in other countries. We may mention, for instance, the telegraph which the Americans have constructed across the Rocky Mountains, and which now joins New York to San Francisco—the Atlantic to the Pacific. But though some time may elapse before Dr. Embling's cherished hopes are fully realized, there are strong reasons why steps should be taken at an early date to test the practicability of establishing a communication by means of camels between this colony and North Australia. At present there is some degree of uncertainty as to the general availability of the overland route. The points at which water my be found are not satisfactorily known; and and, interesting as Mr. Stuart's diary is, there are still many matters relative to the character of the country which are not there touched upon. If, then, the experiment which is now being tried at Van Diemen's Gulf should turn out to be a success, it will be necessary to thoroughly examine the overland route; and this is a work for which the Victorian camels would be admirably adapted. With regard to the question of introducing these animals for travelling in the North, it is a matter of surprise that they have not already been more generally used. Mr. Howitt gave a favourable account of those that were employed in the Burke Relief Expedition. Mr. M'Kinlay, too, spoke in high terms of the camels which formed a part of his expedition. Their valuable services are referred to in various parts of that explorer's journal, and especially in that part which describes the difficulties which were experienced in the flooded country beyond the Stony Desert, where, it is said, the camels were as useful as boats; for when everything else was under water their backs were high and dry, We trust, then, that in any future attempt at opening the interior of the continent, Dr. Embling's suggestion will be acted upon, and that the camels in Victoria will be utilised. He states that the best of them would travel 800 miles, each carrying a man and a letter-bag, in seven days. At some no distant date we have every reason to believe that these animals will be generally used in Australia. The "Camel Carrying Company," that was sought to be established in Adelaide a few years ago, was a failure because its promoters had no fixed idea of what they intended to do; but since that time camels have been fairly tried in Australian exploration, and the experiment has been a complete success. The main part of the scheme, however, which has attracted Dr. Embling's attention, and which is well deserving of consideration, is that the Australian colonies should construct a telegraph line to the northern coast without waiting until the Anglo-Indian line can be extended across the sea to Van Diemen's Gulf. It may be a very long time before this can be accomplished; but it is said that without such a submarine line the colonies might at once place themselves much nearer to England than they are at the present time. It has been pointed out that, with an overland telegraph and with steam communication between North Australia and Singapore, we might receive English news a fortnight later than any which can be brought on board the steamers by way of Ceylon and King George's Sound. With regard to the cost of such an undertaking, the estimate which has been made is as follows:—Overland telegraph, £193,200, at £138 per mile, and four steamers, at £5,000 each, £20,000. But the idea is that the scheme should include means of transit for mails, so that further expenditure would be necessary to provide horses or camels. Altogether the subject is one which the Australian colonies cannot but feel an interest in, and which will force itself upon public attention at a very early date if the colonization of the northern coast should be attended with success.

Conduction of Heat.—In relation to Tyndal's researches, M. l'Abbé Laborde states that he has heated to redness one end of a thin iron bar so long that the other end could be held without burning. When the red end was plunged into water the other end became so hot that he was compelled to drop it. The rapid compression of the hot metal, he says, is no doubt the cause of the elevation of temperature; but he asks if another cause may not be suspected—for instance, the creation of thermo-electric currents. For this purpose he made a rather rough experiment, which is described in *Les Mondes*, Vol. IV., No. 1.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2362. W. Clark, improvements in the means of actuating electric dials or clocks.—A communication.

2388. C. W. Allen, new or improved arrangements or mechanism for communicating between any passenger and the guard and engine-driver of a railway train.

2423. F. N. Gisborne, improvements in the means of working electric signals for gunnery practice.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2218. A. A. Davis, improvements in apparatus for communicating or signalling between the guard and driver and between the passengers and guard or driver of railway trains.

2255. R. T. Hall, improvements in the means of communicating between passengers and guards in railway trains.

2307. C. W. Howell, improved means or apparatus for communicating from the passengers or driver to the guard of a railway train.

PATENTS SEALED.

821. J. Hunt, an improved instrument, or "tell tale," for registering the time of arrival and departure of workpeople in houses of business and manufactories.

819. J. B. Thompson, improvements in electro-magnetic induction machines.

NOTICE TO PROCEED.

1298. W. Passmore, making sewing-machine, rotary hair-brushing machines, electrical apparatus, and lathes, self acting.

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

2464. W. T. Henley, improvements in magnetic and electric telegraph apparatus, which are also applicable to other purposes.—3rd October, 1861.

PRICES CURRENT OF INSULATING MATERIAL.

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India Rubber.

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third Negro-head	1/2½	„
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Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

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100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	104½ to 105	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1 to ½ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 3½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	½ dis. to par	—

TO CORRESPONDENTS.

As information respecting Improvements, Extension of Lines, and Progress of New Undertakings will at all times be most acceptable, we hope that our readers will kindly render us assistance, by furnishing us with brief notices of events and occurrences in connection with electrical and scientific progress.

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THE TELEGRAPHIC JOURNAL.

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MAGNESIUM AND ITS LIGHT.

DR. LIVINGSTONE, Bishop Colenso, and Magnesium, were three of the chief popular attractions at the recent meeting of the British Association in Bath. Professor Roscoe, at his lecture on light, in the theatre, had a table covered with specimens of magnesium, crude, purified by distillation, and in wire. Taking in his hand a lump of distilled metal, nine pounds in weight and about the size of a man's hat, he presented it to his audience as an evidence of the progress made within a few years, before which magnesium was only known impure and in grains, and preserved as a rarity ~~in a few laboratories~~. For this progress the world is indebted to Mr. Edward Sonstadt. About the beginning of 1861 he attacked the problem of the commercial production of magnesium. After many and prolonged pains and countless and costly experiments, his efforts were rewarded with success. In 1863 he presented the Royal Institution with a fine lump of the distilled metal; and in the present year he has been favoured to see a "Magnesium Metal Company, Limited," established in Manchester to work his patents, and who advertise themselves as ready to supply magnesium in any quantity for which there may be a demand.

The first use to which magnesium has been applied is, as a source of light. Its value as an illuminator had been foreseen ere Mr. Sonstadt set to work. Professor Roscoe, in 1859, indicated the fact, and a commission under the Austrian government verified by experiment its prodigious light-giving power, and only on the score of expense, and with regret, set aside its employment as impracticable—a reason which has now ceased to exist. In the Bath theatre Professor Roscoe stated that "a burning magnesium wire of the thickness of ·297 millimetre evolves as much light as 74 stearine candles, of which five go to the pound. If this light lasted one minute, ·987 metre of wire, weighing ·120 grammes, would be burnt. In order to produce a light equal to 74 stearine candles, burning for ten hours, whereby about 20 lbs. of stearine is consumed, 72·2 grammes (2½ ounces) of magnesium would be required." Practical evidence on this head he quickly adduced. Two lamps with large reflectors, in which coils of magnesium wire were paid out by hand as they burned, were lighted. In an instant the house was flooded with a rich white light, as soft as brilliant, in which the colours of the ladies' dresses and the bloom of their complexions were displayed as naturally as in daylight. All eyes kept wandering over the scene in order to enjoy the novel and delightful effect. When at last the magnesium lamps were extinguished, the gas lights, which had been overpowered by their superior radiance, seemed changed by contrast into farthing dips, yielding a dim, sickly, and dirty yellow illumination. In proof the richness of magnesium light in actinic or chemical rays, Sir Charles Lyell was called forth and his photograph taken on the spot by means of two or three bits of burning magnesium wire waved about while held in wooden clips; and shortly, an excellent likeness of the prince of geologists was magnified and thrown on a screen by the magic lantern amid the loud applause of the assembly. At the close of Professor Roscoe's lecture, Mr. Ladd exhibited an electric light, derived from 60 cells of a Grove's battery, when a gentleman stepped forth and held alongside two burning magnesium wires twisted together. The intensity of the electric light was manifest, but the magnesium light did not suffer by the comparison, and considering the simple and impromptu means by which it was obtained, its practical value was most effectively demonstrated.

This exhibition of magnesium by Professor Roscoe excited much interest, and the shop of an enterprising chemist in Bath, who advertised "Magnesium wire for burning, 3*d*, per foot," was day after day thronged with purchasers. It seemed the general opinion that photography would receive a new extension from the magnesium light. Caves, mines, catacombs, and the interiors of the pyramids could now be revealed in myriads of pictures. The photographer would now be enabled to pursue his calling under the gloomiest or the smokiest sky; and very probably he would be called upon to devote his evenings to his art—the time when busy people especially are most at leisure to sit for their portraits. Photographs of Sir Henry Holland, Professors Faraday and Roscoe, and other celebrities, taken at night by the magnesium light, were freely handed about, and except for the inscription, no one could have detected a difference between them and the best work of the sun himself.

Apart from photography it was very plain that in magnesium a new signal light was discovered, which, for handiness at least, set the lime and electric lights at defiance—any one with a bit of magnesium wire and a lucifer match can in an instant produce a light which may be discerned miles off: indeed, the light has been plainly discerned at a distance of twenty-eight miles at sea; how much further remains to be determined. In rockets and fire-works the filings of magnesium scintillate with a dazzling, far-reaching and unequalled power. Already several Governments have taken magnesium in hand and are diligently prosecuting experiments, which, if satisfactory, will result in magnesium being entered as a stock commodity in all their arsenals. Theatrical managers are also experimenting with a view to new sensations in Christmas pantomimes and Easter pieces. Surgeons find the light highly convenient in examinations with the speculum; and chemists discover a hundred uses for it in the laboratory. It is said, some shopkeepers will astonish the Londoners with the light in the course of the winter. Already two patents have been taken out for magnesium lamps, and others are promised. The purposes to which the light may be applied are manifold and every month reveals new ones. Some gentlemen at Bath drew unfavourable inferences against the extensive use of the metal from the high price of the wire, but, if we are not misinformed, 3*d*. per foot is merely a provisional and experimental figure. Whenever there arises a fixed and calculable demand, quite a different price will be quoted. As everybody with any commercial experience may know, price is governed by the scale of production. If iron were wrought on the same scale as is magnesium at present, we question whether iron wire could be vended retail at 3*d*. per foot.

As chemists are aware, magnesium is one of the most abundant metals in Nature. Besides entering into the composition of a large number and variety of less abundant minerals, it constitutes 13 or 14 per cent. of dolomite or magnesian limestone, a rock which is found in almost all parts of the world in enormous quantity. In England, for example, the magnesian limestone formation extends from Tynemouth to Nottingham, a distance of 147 miles, and over at least part of that long line is fully 600 feet thick. Magnesian limestone consists partly of carbonate of magnesium and partly of carbonate of calcium; but carbonate of magnesium by itself exists in immense masses

in some parts of the world, as, for instance, in Greece and in India. In the ocean, moreover, magnesium exists in such quantity that Mr. Sonstadt has calculated that it contains 160,000 cubic miles of the metal,—a mass so great that it would cover the entire surface of the globe, both sea and land, to a thickness of more than eight feet.

Sir Humphrey Davy, in 1807, first revealed the existence of magnesium; but nearly half a century elapsed ere a Sonstadt was found to throw wide the doors to the vast treasure-houses wherein it lay stored. Human nature will be changed indeed if these doors now open should ever again be closed. Not only one of the most abundant metals, magnesium is among the most beautiful. When thoroughly pure, it is as white as silver, readily receives a high polish, and is easily kept clean. Moreover it is very light, its specific gravity being 1·74, or less than a fifth the weight of copper, and almost half that of aluminium, which is 2·60, and until the appearance of magnesium considered a marvel of lightness. An ounce of magnesium and an ounce of silver represent very different bulks. At present, many of the peculiarities of magnesium are undetermined; like all other metals it has a character and oddities of its own which will only become intelligible after multiplied experience. In some cases it shows itself very brittle; in others tough as steel: one manufacturer trying his hand at a magnesium button found his material fly into fragments under pressure, whilst Mr. Conningsby, of the Crystal Palace, struck a medal with ease and perfect success. To what uses, in addition to burning as a light, magnesium will be applied, it would be idle to speculate: time and trial alone can make manifest; but we think that we may safely predict that in the appearance of this metal we behold a new agent of civilization—one which will write a broad line on the world's future.

REMARKS ON CAPTAIN MAURY'S AND M. MARIE DAVY'S LETTERS RESPECTING METEOROLOGIC TELEGRAPHY.

By Admiral FitzRoy, F.R.S.

Having read in the *Courrier des Sciences*, and in the *Bulletin International*, published at Paris, a letter from the celebrated Maury respecting meteorologic telegraphy, in which he gives certain views the importance due to his authority; and as their tendency is not of a *progressive* character—owing, perhaps, to his own able mind having lately been unavoidably engrossed by lamentable internecine war—it appears to me a duty, considering the public interests affected, to comment briefly on my friend's letter.

Captain Maury, like many other really competent and authoritative judges of various scientific questions, has not had time, means, or inclination to study the daily complications and published facts of atmospheric changes.

It is only at such centres of communication and continuous reference as Berlin, Paris, or London that deductions can be drawn satisfactorily, after years of experience.

Not only are telegraphic correspondents at distant stations, in considerable number, indispensable, but the collection and collation of accounts, or descriptions of weather, in as many places as may afford them, must be practicable speedily.

No private individual, unassisted by public aid, can have such machinery, and therefore his opinion of the systems in operation cannot be so valuable as the prestige of his name might lead the public to suppose.

For example, in this office records or data have been gathered and considered during ten years unintermittingly. My assistant, Mr. Babington, has incessantly devoted his chief attention to the constitution and dynametry of the atmosphere, not over Europe and the Atlantic only, but the whole world. We act on the same principles, and it is now absolutely a matter of indifference whether he or I draw the forecasts of weather, or send out cautionary signals.

This *could* not be without a definite system on a truly scientific basis.

At Berlin the esteemed Professor Dové, with thirty years of European reputation, has had accurate and extensive information for many years; while at Paris—excellent centre of continental communication and great telegraphic combination—the eminent astronomer and senator, Le Verrier, well aided in meteorology by a learned electrician and physician, Marié Davy, have vast advantages in considering and treating meteorologic questions.

While these centres of opinion—aided by maritime reports, such as the *Moniteur de la Flotte*, the *Shipping and Mercantile Gazette*, and numerous local publications—have the means of comparing, checking, and duly considering each day's forecast (prévision), and the weather actually occurring afterwards, advantageous sources of opinion are available to which no individual can lay just claim.

In corroboration of what has been said about the general value of forecasts, as applicable to a *range* of coast and *prevailing* direct wind, not specifically to *confined* localities or mere eddy winds, I may refer you to Captain Mouchez, my esteemed colleague in meteorology, at the Ministry of Marine in Paris.

Having premised thus much, allow me to say that, in discouraging such forecasts as are now drawn in France and England, Captain Maury is unaware how completely he would destroy the scientific foundation of telegraphic *cautionary* notices (often, but less correctly, called "storm warnings").

Only in consequence of attentive and incessant study of atmospheric dynamics, as well as certain statical facts, after a due apprenticeship (so to speak) to the very comprehensive subject, can adequate skill be attained in acting with these recently combined atoms of experimental knowledge. Like the not distantly related practical science of magnetism applied to compasses in iron ships, it has yet only a few votaries, its intricacies and necessarily prolonged study not attracting some modern philosophers who would grasp all manner of subjects, although hardly able to realise mentally half the varying conditions of air and ocean. It is supposed by many that forecasts of weather and their occasional results—advertisement of strong wind, or, it may be, warning of a tempest—depend only on notices sent from distant places at which a storm has begun. Nothing can now be more fallacious. True it is that in 1861 we began with the belief that by such aid we might do so. But advances have been made day by day; and during the last year or more cautionary notices have often been sent by telegraph to the farthest stations, even most toward the coming storm (or to windward of us), in good time to warn them of the preparation necessary to be made in an exposed seaport, such as Valencia or Aberdeen. As I have said elsewhere on this naturally, and *very* properly *disputed* question, facts are as the ground, telegraph wires are roots, a central office is the trunk, forecasts are branches, and cautionary signals are as fruits of this youngest tree of knowledge.

Permit me now to turn for an instant to some special facts, too little known even to one so well informed generally as the sagacious Maury.

In the zones of the world usually called temperate true east winds are so rare that they become quite exceptional. What we call in general parlance easterly, or east winds, are polar currents, more or less deflected by meeting opposition of air or land.

In these zones the atmosphere has a general progression toward the east. Storms, or vast eddies between great breadths of mutually antagonistic currents of air, are therefore carried along (translated) toward the east (more or less deflected by local conditions toward the north or south), and having passed the meridian of any place, are *gone*—excepting their rearward effects—as far as the places under that meridian are concerned. Such storms may not, however, reach very far in a meridional direction, although travelling eastward during *two or three days* on rare occasions. Hence it is obvious that in temperate zones stations for special warning stations are required north, west, and south of a centre, but not toward the east, except for general information, and to be themselves warned.

Ask the learned and most experienced Quêtélet, who so satisfactorily presided over the Brussels Meteorologic Conference in 1853, whether he ever has observed any continuance of true east wind in Belgium, or inquire from any person of experience, at sea especially, whether the so-called east wind is not a north-easter or a south-easter while in *force*.

In this country, as in America, some *misquote* the lamented Espy (who said the wind blew from places of high barometer toward those of low pressure), by ascribing to him a most unmathematical corollary, that all gales are "straight lined," and that cyclonic circuits are "fallacies." Such persons surely betray themselves. Air moving from various spaces of high tension toward a limited area of *depression* must meet, and have a tendency to gyrate, being

unable to go far upward on account of gravity. Any such upward determination must tend, however, by its overflow to augment the tension or pressure about the outer portions of any such circuit.

We find here that the main currents, polar and tropical, have very different electric characteristics—one, the polar, being always plus; the other always minus, if pure (unmixed with the polar).

We also have found the telegraph wires much disturbed when these main (principal) currents were beginning to act positively in force. No great tempest, no heavy polar or tropical gale has occurred here since 1860, without more or less "*wire disturbance*" (as the telegraphists say), and I am led by these, with other concomitant facts, and examination of numerous sea records, as well as registers on land, to believe that such electric effects are caused by atmospheric collision, and that "*magnetic storms*," sedulously watched now at many observatories, are *results* of atmospheric storms, somewhere in one hemisphere or the other, instantaneously felt through air, however remote—either by conduction or by vibration—as an earthquake is felt on board ship in the middle of a deep ocean, even the South Pacific.

In the *Bulletin International* of the 12th instant M. Marié Davy asked, "*A quelle cause devons nous attribuer ces grands tourbillonnements de l'air?*"

Having particularly studied this interesting branch of atmospheric dynametry, and trusting to authorities like Sir John Herschel, Professor Dové, and others, during whose lives meteorology has been one of their pursuits, I will venture to offer a few observations.

Assuming that Hadley's and Halley's original hypotheses are sufficiently supported by the best subsequent authorities, and definitively proved by recurrence of accumulated facts, by adding to *their* views Dové's "parallel currents" and "gyrations" of wind, besides Herschel's "antitrades," we are enabled to advance at once into details, easy *now* to trace out and connect.

Without adverting here to views circulated from the Board of Trade since 1855, it will suffice to say that certain *periodic* effects of temperature and of *gravitation* have been traced by facts, whence the following *four* inductions seem warranted.

First—A very small tidal effect, caused semi-diurnally by solar influence, and felt (meridionally) about the torrid and tropical zones.

Second—A solar tide, however small, due to gravitation, and only evident by its dynamic effects *horizontally*.

Third—A lunar tidal action, not evidenced vertically but *laterally*, and with *force*.

Fourth—A *mutual* attraction and consequent tendency (not unlike the effect of induced magnetism) between contiguous volumes of air, which occasions more or less adhesion (or resistance to separation) when they move, and a certain friction that may have *any* degree of force, from the gentlest movement *of a light breath to the escape of steam from a boiler into cool air, developing electricity* (as seen experimentally at the Polytechnic). Now these results (facts accordant to philosophic principles), when combined with previous generalizations in their application, may be found adequate to solve many interesting, but hitherto obscure, problems in meteorologic dynametry, those especially which have immediate reference to practical *forecasting* of the *weather*.

The first is familiarly known to meteorologists as depending on the sun's position, and being regular to an hour or two, though not recurring exactly (as said by some) in *all* intertropic places, because occasionally affected by peculiar local conditions, such as high mountains, arid deserts, heavy continuous rain, or by storms.

The second effect of solar attraction is shown by the differences between syzygial and intermediate results, observed in connection with those of the moon's action.

The third and by far the most important disturbing cause, next to *heat and cold*, appears to be lunar attraction. But this effect of gravity is not *apparent*—like oceanic tides. Oceans are intersected by land; water is an inelastic fluid; a tidal impulse is not soon checked—the ocean *in mass* seeks equilibrium;—after disturbance it reverts, and with acquired momentum does more than restore itself to position—it advances *eastward* and then again *recoils* from its eastern boundary.

Air, our atmospheric enclosure, from 10 to 15 miles in depth, (practically considered), is free to move in *any* direction,—excepting against a few high ranges of mountains such as the Himalayas and Andes, which an *average*, are not three miles high, and do not extend through *many* degrees (*meridionally*) at their highest elevation; although a few peaks attain four or five miles in measured altitude.

The combined effect of moon and sun, or the "*luni-solar*" action of gravity on this *outer* atmosphere, has a tendency to draw it toward and after those bodies, as the earth turns eastward, whence motion, as of a perennial current, might be caused, did not "*ante-attraction*" (anterior effect on the mass *approached*) and centrifugal impulse of rotation, act in a contrary direction.

Antagonistic forces being thus nearly balanced in effects, no important longitudinal or equatorial, or east to west movement of fluid air exists; but the *waves* raised and *upheld* (by sun or moon, or by both *together* at syzygy), *under* which has been an indraft, with momentum—are constrained to subside by *overflow*—running off in horizontal currents *meridionally*.

While so *lifted*, upheld by moon's or sun's attraction (however much above normal elevation) very little tension or sensible pressure on a barometer differing from that read off a few hours sooner or later would be noticed, because the earth's attraction diminishes as that of the luminary increases; and there would be no *other* reasons, *usually*, for barometric effects, of much comparative moment.

In those regions there would be no mutual *antagonism or over-running* of air currents, no condensing body of cold dry polar air acting, as in temperate zones.

Not *long*, however, does *upper* air retain a *meridional* direction, whether maintaining its *equatorial* velocity, for a time,—and therefore moving more and more toward east, as meridians converge—or only impelled, by *tendency to equilibrium*, toward the polar regions —whence air is incessantly drawn that must be replaced.

In considering luni-solar attraction—the *difference* between vertical action and tangential, that on the torrid zone, and at the poles (so dissimilar in their *directions* and in their *effects*), should be carefully considered—one being *direct* the other as it were *glancing*.

High mountains and clouds crossing stars afford the most direct evidence in *low* latitudes of *upper* currents occasioned by luni-solar action. They are always seen in the tropics. Their variations and *periodicities* of effect have been observed to correspond nearly with lunar *intervals* (not *usually*, though sometimes, with the *phases*).

Hence ample causes exist for variations in force and regularity of upper, returning, or tropical currents of air, which must occasion many consequent irregularities in the lower advancing, or polar winds, even in low latitudes; but vastly more in the temperate zones, where other circumstances operate, and *variously*.

Volumes of tropical air, from around the whole world, thus pressing from every direction along, or across, converging meridians toward the poles—occasion incessant *antagonism* from polar currents in the middle and higher latitudes, but especially in the temperate zones.

Instead of passing *over* these advancing breadths of atmosphere the winds from tropical zones, when near middle latitudes, *usually* move along earth's or ocean's surface more or less interrupted, intermixed with, opposed or displaced by, occasional polar winds; —and the collision of these incessantly antagonistic currents—at variance in quality and quantity, as well as in direction—is proved to be the cause not only of our storms, but of all minor changes, and of their *ordinary*, more or less rotary (rather indeed *semi-rotary*) effects, as commonly witnessed.

When two currents are passing in opposite or different directions —each acts on the other—and between them (if both move) is a *comparatively* neutral space. Unless very forcibly pressed together —by lateral, cross, or *wedging* action—each current yields, in some degree, to the other—(elastic air much more than water). If one be moving (say) to south-west—the other toward north-east—each some hundred miles in width (however shallow) there will probably be a space of very many miles between them, in which the wind will change from one point to the other, through a semicircle, or other curve, gradually (if *moderate*), and thus an appearance of turning, semi-rotation, or gyration of wind, is caused, at any station, in a simple manner, irrespective *of earth's motion*. Through the *next* current of air, *direction* of wind remains steady or nearly so, until the western edge approaches, when a similar *half turn* commences, which, with the former, completes a gyration, when the other stream, or current, attains the place of observation, not usually by direct, but by *lateral* progression (as they move eastward with the whole mass of atmosphere in that zone).

As the *highest* barometer and *lowest* temperature are about midway in the polar current—the lowest or least tension, with the warmest air, being near the middle of each tropical current—it is natural that tabular co-ordination, in curves, on a diagram, should have induced ideas of "*atmospheric waves*," moving from north-west to south-east.

When antagonistic or even crossing currents act *impulsively* against each other—forcibly, and with momentum—more than half a turn—even a cyclone is caused. If violently, and its *causing currents persist*, such a cyclone may last two or three days, and be carried on eastward between its originating currents.

Observations have shown that impulses or "*pulsations*" extend from tropical latitudes toward the poles; that they are resisted and divided into *currents* unequal, irregular, and diverging (as it were) projected like tongues, streams, or shoots, from broad tropical impulsions, which sometimes advance like immensely wide "bores" (of rivers) causing great commotions, such as storms, cyclones, gales, or squalls, along their *front*, and between the *streams* sent on in advance some hundred miles, more or less. The alignment of the front of such an impulsion (tropical "*downrush*" of Herschel) is north-west and south-east, nearly (if not altered by land).

As thus impelled with great momentum outshoots advance, and alternating volumes or streams of polar wind, are met;—by which collisions, squalls, semirotary, or even cyclonic, are caused—tension is raised by mechanical resistance—temperature is affected, and storms often follow.

Such movements occurred on a *great scale*—early last December, when a tempestuous space extended from the Atlantic to Italy, and some observers thought that one and the same storm, even the *same cyclone*, traversed Europe from Ireland to Rome, in little more than 24 hours,—therefore imagining that the *centre* of the storm moved about fifty miles an hour; with which the wind's velocity at one part of the gyration must then have been about 130 miles an hour *continuously*.

Such a view requires the progress of that storm to have been from the north-west toward the south-east, which our charts show did *not occur*.

It travelled, as usual, *toward north-east*, while *other* rotary or semi-rotary storms were occurring in the south of France and in Italy,—all within two or three days of each other, between the Atlantic and Adriatic commotions — but *different* disturbances, occasioned by the same great tropical action against Arctic cold atmosphere.

Usually such tropical impulses seem to divide or branch off into currents—as any resisted water-wave impels streams onward horizontally, which separately intermingle with other *resisting* fluid, at rest or moving antagonistically.

To produce a *complete* cyclone there must be *great forces* engaged, in order to cause sufficient impulse, with momentum, for entire and *continued* rotation.

Many, if not most of the gales, supposed to be *cyclones* (in *one side* of which the observer *seemed* to be) are believed by the present writer to have been such *semi-rotary* effects of adjacent currents, in antagonism, as have now been described.

All the effects of gyration, or rotary change, may be explained by consideration of currents moving *variously, while all are uniformly translated* toward the east in the temperate, but toward the west in the torrid zone.

In connection with these subjects a few remarks on the *Bulletin International* may be not entirely out of place, or unacceptable, it is hoped.

Since the first appearance of meteorologic charts *last summer* (in that valued daily publication), attention has naturally been drawn to the marked isobarometric curves, which seem indicative of such combinations of movements as have been outlined in this paper, intermixtures of advanced tension in a *south-west* to a *north-east* direction, and parallel breadths or bands of alternate high and low tension in similar *lines*, *sectional* diagrams of which have a wave-like curve, which shows the greatest *apparent* undulations in a *north-west* to *south-east* direction—whence a double curve or intersection.

Neither isobarometric *curves*, nor any kind of wave or *crest lines*, seem to show *directions* of wind.

How can they? Winds being dynamic *currents*, occasioned by differences of atmospheric conditions, tensions, and temperatures—while lines of approximately equal tension are *statical* positions, showing quantities, or amounts (but not directions), whence the varied *dynamic* consequences are derived.

But they might be shown by *other directional lines*.

We have heard and read a good deal about "atmospheric waves," and winds supposed to be their *consequences*, but I have not yet been so fortunate as to discover any author's illustrations of the *practical manner* in which a wave (supposed) from north-west does occasion a south-west or a north-east storm. The mechanical action, the horizontal (or other) motions of fluid air, in volumes, zones, or bands, have not been traced out, or followed satisfactorily. Yet they must be the basis of practical meteorology.

Not irrelevant to these atmospheric questions, and a subject of extreme interest to speculative meteorologists, is the problematic uncertainty respecting our atmosphere's extreme periphery.

Poisson, in his "Treatise on Heat," assumed that the excessive cold of space has a condensing effect on air, causing it to become viscous; and a very eminent mathematician lately wrote to me, saying, that he inclined to a similar view, if not to a belief in its actual *congelation*.*—*Frozen air* around our atmosphere! *Is there air*, or only the lightest of all gases beyond our *sensible* atmosphere? How would centrifugal force affect air in a comparatively solid state? How would transmission and refraction of light be affected? What effects would there be on heat—on tides of air, and on the passage of *meteorites* (if extra mundane in origin)?

These and other great difficulties appear to be in direct opposition to such theories; however eminent the mathematicians may have been by whom they were supported.

There may be a less involved and difficult explanation of this subject (a solution, possibly, of the chief questions) attainable by careful consideration of the dynametry of air, or water, displaced by a solid body moving through either—and by expanding the simile, infinitely.

As a ship passes through water a certain quantity of fluid almost adheres to the solid body, and is drawn along, by induced or cohesive attraction, causing some friction. Close adjacent to this slight, even *film*-like quantity, the fluid has less impetus *along with* the ship, and still less as distance increases,—the practical result being that a band, or ribbon-like strip of fluid is drawn onward by and with the ship—actually following after in the wake.

Disturbance caused by the ship's motion affects a certain extent of circumambient fluid, but less and less, as distance from the motor augments, until destroyed by resistance.

May we not imagine that a somewhat similar process is in operation, however vastly grander the scale, around our world? The whole depth or body of atmosphere (*sensibly* ten miles, or thereabout) may be carried on, and around with earth, as a band of water is drawn along by a moving ship; the extreme exterior portion, above the highest mountains, having a gradual inclination more or more *westward*, till lost, as to matter and motion, in the immensity of space?

Either a *gradual* diminution of such a kind as this must take place, or a *definite limit* of material fluid, air, or gas must be imagined.

And such a *material* limit would demand some kind of demarcation in extent, with relation to effects of centrifugal force, and much more consideration respecting its bearings on light, heat, and their correlatives, than have been applied to our atmosphere, on a supposition of gradual attenuation without definable limit.

THE INDO-EUROPEAN TELEGRAPH.

The *Levant Herald* of the 21st and 28th ultimo furnishes the following particulars of this important line, which, we are assured by our correspondent at Constantinople, may be relied upon:—

Accurate information with respect to the Anglo-Indian telegraph is, we know, eagerly desired in Europe. The benefits, international and commercial, which would accrue from the completion of this undertaking are so remarkable and manifest, that their repetition would be like the reiteration of a thrice-told tale. The rupture of the Persian Gulf cable, the disturbances in the Montefik district near Bagdad, and the general undefined rumours which are floating about, have left the vague impression upon public mind that all is not going on well with this great international enterprise. The best way to correct these hazy notions, and to lay before the public the actually existing state of things, is to describe in a few words what the circumstances precisely are. Communication from India to Europe—from Calcutta to London—the realization almost of an *Arabian Night's* dream—will be accomplished, in the main, through the submarine cable laid down in the Persian Gulf, and two land lines from Bagdad, one through exclusively Turkish territory by way of Montefik, and the other by a more circuitous route through Persia, converging eventually at Constantinople, and thus becoming connected with the general European network of telegraphic inter-

* Sir John Lubbock, Bart., F.R.S.

course. The cable laid with so much difficulty across the Persian Gulf—the link which is, to borrow an architectural phrase, the key-stone of the arch of the whole undertaking—has, like its great Atlantic prototype, been broken. This is a fact as frequently asserted, and as often denied, in the fluctuating telegraphic news of our Western contemporaries. But we are glad now to be able to state authoritatively that the rupture luckily took place in shallow water; that all conceivable efforts of modern science and energy are applied to effect its comparatively easy repair; and that Colonel Stewart, and the other promoters of the enterprise, now in Constantinople, are in hourly expectation of receiving news by way of Egypt that the repairs have been effected, and that communication is restored.

That being the case, in what way will the line be completed to Western Europe? The Turkish line—the line from Bagdad through Turkish territory—hangs fire. Passing through a chronically-disturbed district, the district occupied by the nomad tribes of the Montefiks—tribes which still keep up in the heart of Asia Minor the picturesque traditions of the independent and semi-robber clans of old—the physical construction of the line meets with easily conceivable impediments. The Turkish pashalic Government, being scarcely able to maintain its authority and hold its own in this seething territory, is hardly in a position to afford much real help and protection to the common-place but essential requirements of theodolite carriers, surveyors, pole erectors, and the rest of the requisite mechanical constructors of a telegraphic line. Irrespective, however, of Arab disturbances, a deadly enemy stops the way of the material march. At this season of the year the mephitic exhalations from the Tigris, and the swampy lands which border it, are perdition to all within their reach, and furnish an invincible practical obstacle in the way of labour. It is not to be hoped that the line in this direction can be continued in the present year. But fortunately another route is open, not through Turkish territory, but by way of Persia—a circuitous route certainly, but a route which, presenting no physical obstacles whatever, and being prolific only in diplomatic difficulties, has been thoroughly utilised by the skill and energy of English engineers. This long portion of the Anglo-Indian telegraph is now complete, with the exception of what the Scotch would call a "bittock" at the Turco-Persian frontier. This brief lapse could be completed in a few days, and news brought direct to Constantinople from Bombay. Telegrams might now be received in ten minutes from Bushire. Unhappily, however, a political difficulty here intervenes. The Persian and Turkish Governments cannot agree on the frontier question. It is only plain justice to state that the fault does not lie with the Turkish Government—they are ready to facilitate the enterprise in every way; but the obstacles have cropped up out of Persian perversity. Why do the Persians raise difficulties? Not in any way wishing to foster Mr. Urquhart's Russophobia, we owe it to truth, nevertheless, and to the sequent facts of history, to state that the Persian Government has been prompted in this course of obstructive obstinacy by the direct agency of the Russian Government, who jealously dislike any disturbance of their universal monopoly in Persia, and who, having a telegraphic line of their own in course of construction through Persian territory, do not hesitate to throw all obstacles in the way of the completion of the great Anglo-Indian line of telegraph through the Persian dominions. This is, however, a matter rather for diplomatists, and we do not doubt that the difficulties of the nature referred to will be, with time, patience, and remonstrance, duly overcome.

Thus we shall get this great line linked with Constantinople, and telegraphic messages from Cornhill to Calcutta will pour to and fro. In its affiliation in this way with the Turkish line of telegraphs, the hearty co-operation of the Turkish telegraphic authorities is of essential importance. This has all along been understood; for many months past *pourparlers* on this subject between the representatives of the Anglo-Indian line here, telegraphic and functionaries, the English embassy, with all its power and authority, in a quiet way have been the order of the day. And we are glad to learn that the new Director-General of Turkish telegraphs, Agathon Effendi, clearly discerns the great international importance of this matter. He manifests a sincere desire to co-operate and aid. He wishes to identify the Turkish telegraphic administration with this vast enterprise, and concurs in the arrangement that English clerks, who are best suited to expedite English messages, should be appointed throughout the whole transit in Turkey, and that these clerkships should be bestowed, not on account of any personal favouritism, but in consequence of legitimate qualification alone. This is the exact story of the present position of the Anglo-Indian telegraph. It would require a pamphlet to enter into all the details, and dilate upon the manifold considerations which the work suggests; but he who runs may read what we have written, and gather an accurate notion of the position of the enterprise at this moment.

The actual position of the Indo-European line of telegraph—instantaneous connecting link between India and home—is of so much interest and importance, that every detail of its progress will be watched with eager interest. Having already described what in the main are the political and international circumstances of the undertaking, we will give a rapid summary and synopsis of the existing material conditions and general prospects of this great telegraphic enterprise. The subject might make an abstruse German philosopher reflect, and at the same time stir the flagging pulses of the most torpid Turk. The Atlantic telegraph between both hemispheres, spanning the ocean and bringing England and America into immediate contact, has been the first to pioneer the way. Its practicability has been indubitably established through the messages between the American President and our Queen, which were flashed along the electric wire across the broad Atlantic; and the Great Eastern—that mammoth vessel whose career is in itself a sort of unhappy romance—is now making ready to convey a new and improved cable for submersion in the deep, in order to accomplish the scientific and civilising mission to which it is destined.

While we look with interest at the effort to connect England with America by the agency of the submarine wire, we look with even nearer and keener anxiety to the great telegraphic enterprise which will bind India and Europe together, and make the two worlds one. A single fact is worth a flood of general speculations; and we cannot better give a clear idea of the actual condition and hopeful prospects of the Indo-European telegraph than by a short report of the interchange of messages which took place by that line on the 17th and 23rd instants between Constantinople and Bagdad.

Communication was commenced from Constantinople, from the Turkish telegraph-station at Scutari, on the Asiatic side of the Bosphorus. There were in attendance here—Agathon Effendi, the new Director-General of Turkish telegraphs; Lieut.-Colonel Stewart, R.E., C.B., Director-General of the Government telegraph to India; Mr. L. W. Courtenay, the resident delegate of the Indian Government in Constantinople for the enterprise; as also Mr. A. Kersting, assistant-superintendent, and Colonel Goldsmid, who had just returned from an inspection of the whole line from Bagdad. At Bagdad, Lieut.-Colonel Kemball, C.B., Her Majesty's Consul-General, with some Turkish authorities, and the local telegraphic staff, were in attendance. The communication was most satisfactory. The average speed sustained was from eight to ten words a minute, and there is no doubt that when all the intermediate stations are thoroughly acquainted with the relays, and acquire that facility in their work which practice alone can give, this speed will be exceeded. Conversation was kept up briskly throughout Asia Minor, to and from the Sea of Marmora and the Persian frontier. The distance from Constantinople to Bagdad is about 1,330 miles, the line passing throughout through Ottoman territory: and the intermediate stations, with the intervening distances, are as follows:—Scutari to Ismid, 55 miles; Ismid to Mudurlu, 104 miles; Mudurlu to Angora, 111 miles; thence to Yuzgat, 113 miles; thence to Sivas, 140 miles; Kharpoot, 178 miles; Diarbekir, 77 miles; Mardeen, 61 miles; Djezireh, 104 miles; Mossul, 91 miles; Kerkook, 114 miles; Bagdad, 189 miles. Of these stations the principal are (in addition, of course, to Scutari and Bagdad), Angora, Yuzgat, Sivas, Kharpoot, Diarbekir, Mardeen, and Mossul. From Bagdad to Fao, at the mouth of the Shat-el-Arab on the Persian Gulf, through which the line will pass when the Montefik Arabs and the healthy season will permit its safe construction, is 400 miles. From Fao to Kurrachee the submarine cable stretches along the bottom of the Persian Gulf for 1,300 miles, and 500 miles further carry us across a portion of our Indian empire to Bombay. "What do you wish to know?" asked Colonel Kemball at Bagdad of Colonel Stewart at Constantinople, when the telegraphic communication was made. "Have you any news of the Persian line, and of the repair of the cable?" was Colonel Stewart's inquiry. Colonel Kemball, in reply to this and succeeding questions, answered that the Amberwitch was busy repairing the cable, and that news of its completion might be daily expected; that the health of the telegraphic staff at Fao and Cape Mussendom was quite satisfactory, but "very unhealthy," unfortunately, at Bushire. Colonel Kemball also undertook, at a suggestion of Colonel Stewart, to write by

the Persian courier, who was just then about to leave Bagdad for Teheran, to Colonel Champain, who has charge of the construction of the Turco-Persian line, requesting him to telegraph to London the news of the completion of the repairs of the cable as soon as effected, and the probable period of the opening of the Turco-Persian line. Colonel Kemball then asked what was the latest news from America, and it was replied that General M'Clellan had been nominated candidate of the Democratic party at the Chicago Convention, and there might be some probability of peace. Colonel Kemball then telegraphed that he, and the other subscribers to the *Levant Herald* at Bagdad, received their papers very irregularly, which was a great deprivation to them, and begged of Colonel Stewart to apprise the editor of the circumstance. [The gallant colonel's message has been duly communicated to us, and we have made it the subject of formal complaint to Agiah Effendi, the Postmaster-General. We regret to state that the Turkish post is vexatiously irregular.] A lengthened conversation then ensued as to measures to be taken for the completion of the line to Bussorah as soon as the state of the country would allow it; details were entered into with respect to the distribution of stores, materials, &c., and the *séance* closed with mutual thanks and congratulations.

All interested were much gratified at this successful practical experience of the direct working of the Indo-European line, and we are sure that our readers, both here and at home, will cordially share their satisfaction. Agathon Effendi was much pleased; and we are glad to know that the new Director-General of the Turkish telegraphic service fully appreciates the importance of this line to the Turkish empire, and the great increase of Turkish telegraphic revenue which must accrue from its working. Colonel Stewart and his colleagues are preparing the tariff of charges to be adopted; and we may mention for general information that the cost of a message of twenty words from London to Calcutta will be fixed at about £5, and so on in proportion.

ON THE INFLUENCE OF TEMPERATURE ON THE ELECTRIC CONDUCTING-POWER OF ALLOYS.*

By Augustus Matthiessen, F.R.S., Lecturer on Chemistry in St. Mary's Hospital, and Carl Vogt, Ph.D.

The influence of temperature on the electric conducting-power of the pure metals in a solid state has been proved to be very great,† and as very little is as yet known with regard to the influence of temperature on the electric conducting-power of alloys, we undertook this research in order, if possible, to discover the law which regulates this property.

For the sake of clearness, we have thought it advisable to divide this subject into four parts, and they will be treated of in the following order:—

1. Experiments on the influence of temperature on the electric conducting-power of alloys composed of two metals.
2. Experiments on the influence of temperature on the electric conducting-power of some alloys composed of three metals.
3. On a method by which the conducting-power of a pure metal may be deduced from that of the impure one.
4. Miscellaneous and general remarks.

1. *Experiments on the Influence of Temperature on the Electric Conducting-power of Alloys composed of two Metals.*

It will be as well to mention that, from the few experiments already published on the influence of temperature on the conducting-power of alloys, we had at the commencement of the research some idea of the law which regulates this property, and having found after a few experiments our supposition confirmed, we were able to shape the course we intended to pursue in such a manner as to curtail the number of alloys to be experimented with. Thus, with the alloys made of the metals, lead, tin, cadmium, and zinc, with one another, instead of using the alloys

$$Pb_6\,Sn,\ Pb_4\,Sn,\ Pb_2\,Sn,\ Pb\,Sn,\ Pb\,Sn_2,\ Pb\,Sn_4,\ Pb\,Sn_6,$$

and testing in the same manner the tin-cadmium, tin-zinc, cadmium-zinc alloys, we only used the following,

$$Sn_6\,Pb,\ Sn_4\,Cd,\ Sn_2\,Zn,\ Pb\,Sn,\ Zn\,Cd_2,\ Sn\,Cd_4,\ Cd\,Pb_6,$$

thus forming a mixed but complete series. Other groups of alloys have been treated in a similar manner. The reason for grouping alloys made of different metals under different heads has already been elsewhere discussed.* It has also been only considered necessary to experiment on one wire of each alloy, as the results obtained agree in most cases very closely with those calculated, and as it has been proved by a few determinations, which are given in the following table, that the same values were obtained for the percentage decrement in the conducting-power of the alloy between 0° and 100°, when series of determinations were made with two wires of the same alloy:—

Alloy.	Volumes per cent.	Percentage decrement observed between 0° and 100°.	Remarks.
Gold-copper (hard drawn)	98·63 of Au	21·87	Series made with wires of different specimens of the alloy.
Gold-copper (hard drawn)	98·38 "	21·75	
Gold-silver† (hard drawn)	52·08 "	6·50	
Gold-silver (hard drawn) .	52·08 "	6·48	
Gold-silver (annealed) . .	52·08 "	6·72	
Gold-silver (annealed) . .	52·08 "	6·70	Two series of determinations made with the same wire.
Gold-silver (annealed) . .	52·08 "	6·71	
Gold-silver (annealed) . .	79·86 "	10·15	
Gold-silver (annealed) . .	79·86 "	10·21	
Tin-cadmium	23·50 of Sn	28·89	Series made with different wires of the same specimen of the alloy.
Tin-cadmium	23·50 "	29·08	

The method and apparatus employed for the determination of the conducting-power at different temperatures was the same as that described and used for the experiments on the pure metals.‡ We have, however, in many cases only taken observations at three intervals, as we found that almost the same formula was deduced from observations made at three different temperatures as from seven, especially when the temperature of the second observation was the mean of the other two; now, as three or more observations were made at each interval, it was easy to obtain the wished-for temperature as the mean of several determinations. Thus, the formulæ deduced for correction of conducting-power for temperature of the alloy $Cd\,Pb_6$ were—

From seven observations . . . . . $\lambda = 9{\cdot}287 - 0{\cdot}032501t + 0{\cdot}00006743t^2$.
From three observations . . . . . $\lambda = 9{\cdot}286 - 0{\cdot}032450t + 0{\cdot}00006683t^2$.

Again, those deduced for the alloy $Sn_2\,Zn$ were—

From seven observations . . . . . $\lambda = 16{\cdot}876 - 0{\cdot}065544t + 0{\cdot}0001471t^2$,
From three observations . . . . . $\lambda = 16{\cdot}899 - 0{\cdot}065790t + 0{\cdot}0001454t^2$,

where λ represents the conducting-power at $t°$ C.

We have here taken, as in former papers, the conducting-power of a hard-drawn silver wire at 0° = 100 as defining our unit. The normal wires were made of German silver, the resistances of which were determined by comparing them with the gold-silver alloy,* the conducting-power of a hard-drawn wire of which is equal to 15·03 at 0°.

The tabular statement hereunder contains the conducting-powers, specific gravities, and equivalents of the metals used for making the alloys. These values are those which have been used in calculating the results given in this paper:—

Metal.	Conducting-power at 0°.	Specific gravity.	Equivalent.
Silver (hard drawn)	100·00	10·468	108·0
Silver (annealed)	108·57	—	—
Copper (hard drawn)	99·95	8·950	31·7
Gold (hard drawn)	77·96	19·265	197·0
Gold (annealed)	79·33	—	—
Zinc	29·02	7·148	32·6
Cadmium	23·72	8·655	56·0
Palladium (hard drawn)	18·45	11·500	—
Platinum (hard drawn)	17·99	21·400	—
Iron (hard drawn)	16·81	7·790	—
Nickel	13·11	8·50	—
Tin	12·36	7·294	58·0
Thallium	9·16	11·900	—
Lead	8·32	11·376	103·7
Bismuth	1·245	9·822	208·0

In the treatise before us the authors here append a number of tables, which would occupy too much space if reproduced in these columns, showing the results obtained with the alloys belonging to

* Extracted from a paper read at a meeting of the Royal Society, 18th June, 1863.
† Philosophical Transactions, 1862, p. 1.

* Philosophical Transactions, 1860, p. 162. † Ibid, 1862, p. 1.
‡ Philosophical Magazine for February, 1861.

different groups, with some alloys made of those metals which, when alloyed with one another, conduct electricity in the ratio of their relative volumes; and those with some alloys of those metals which, when alloyed with one another, do not conduct electricity in the ratio of their relative volumes, but always in a lower degree than the mean of their volumes, &c.

(To be continued.)

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.*

A.D. 1766, June 10.—No. 850.—Knight, Gowin [Gowan].—"Constructing compasses, so as to prevent them being affected by the motion of the ship," &c. "The card and box" "are made to oscillate in equal times, by placing the centre of gravity both of the box and of the card" at proper distances "from their points of suspension," and by fixing an adjustable weight to act as a "pendulum" "to the rim of the outward gimbol, under the axis, by which the outward gimbol may be made to move in the same time as the inward. The inward axis or gimbol is fixed to the bottom of the box." The agate receives the point on which the needle moves, that point being attached to the needle by means of a metal "cross piece," having "small gimbols." "The agate is fixed to a slender stem of metal, the lower end of which is pointed," and turns freely in "a hollow socket." "The socket is fixed as a pedestal in the centre of the bottom of the box, and has a slit on one side," to admit a pendulum screwed to the lower part of the stem. When "the box is in motion," the pendulum, "stem, and agate, will move to and fro." Also, "constructing the variation compass," "for taking the sun's azimuth and amplitude, and the bearing of distant objects." A moveable "mirror is placed at each end of the index, just behind the sights," "so as to reflect" "the graduated rim of the card, which will then appear to the eye" vertical, and cut by the "thread of the opposite sight," which also cuts the object. "In taking the sun's azimuth," when its height is considerable, "the rays of the sun are reflected from a small polished cylinder placed behind the sights, and an opening is made in each end of the index bar, that the brass rim may be reflected without interruption from the bar, which is slit, that the shadow of a thread underneath it may cut the graduated rim of the card."

A.D. 1779, June 25.—No. 1229.—Wright, Gabriel, "a new-constructed and amplitude compass." "The new-invented parts" and "improvements" consist of:—"A horizontal nonius (or verniers) division," "having a vertical motion" by means of a nut outside the compass box. An "index and sights, which goes on the compass box," used when the sun's azimuth or amplitude is taken. Two "mirrours" are "placed at right angles to each other on the plane of the index;" also "a screen or dyed glass," and "a convex glass." "To the vertical sight" "is fixed a horizontal one," "to look down on the reflecting glasses, &c., to view the sun and the horizon of the sea, and to read off the degrees from the card, &c., through the convex glass." "At the other end of the index" is placed a weight "to balance the whole." Also an improved "reflecting quadrant or octant, having the following new parts:"—"A round plate" (with "a hole," "a circular slit," and "a milled edge"), "carrying the index glass," and moving round the centre of the index, adjusted by a "clamp and screw;" "a horizontal screw" adjusts the index glass to the horizontal glass. The index glass has a horizontal fine hair line. A piece of brass is screwed to the quadrant frame, having "a fine division cut on it," and adjusted "to coinside with a like division cut on the edge of the round plate." A "sight vane," "having a piece of thin brass with a hole in the centre," sliding up and down in a "slit," "so as to view objects in the true plane of the quadrant." "A brass frame," carrying a hair line, which sometimes takes the place of the sight vane. A "sight vane," with two lines drawn across the inside ("used with the compass in taking the sun's azimuth and altitude at the same time"), is "fastened to the arch of the quadrant." "A reflecting glass," to view objects from 140 to 180 degrees apart. "A cylindric box with two parallel glass sides," filled with a liquid that will float a hair (attached to a cork and weight) vertically, "to level the compass by when the horizon of the sea cannot be observed."

* Published by authority of Her Majesty's Commissioners of Patents.

A.D. 1782, February 5.—No. 1318.—Nairne, Edward.—This invention is stated in the title to be a "New-invented and most usefull improvement in the common electrical machine (which I call the insulated medical electrical machine), by insulating the whole in a particular manner, and constructing the conductors so that either shocks or sparks may be received from them." The "form to be excited" of this electrical machine is "supported immediately on non-conducting substances." "The conductor or conductors which either give to or receive the electrical fire from the excited part, is composed of a coated electrical jar or jars, or any other substance than" [that?] "can receive a charge of electricity or conducting substance connected with them." Connected with these "conductors" are "tubes" or "rods," with ball and socket joint or joints, that will conduct electricity, to direct the electric discharge to any part of the body required; and by these means shocks are given by discharging the electricity (either by metallic connection with the earth, or with the conductor of the opposite kind of electricity) when at some distance from the part through which the shock is to be sent; if sparks are required the distance is lessened. By means of the "conductors" and jointed "tubes," the human body can be in any part affected with either kind of electricity in any convenient manner.

A.D. 1782, March 20.—No. 1322.—Heriot, James.—A "New invented mariner's compass, with compass boxes or bittacles, pendent or standing, with ventilator, to contain either lamp or candle, as occasion may require, calculated to obviate every difficulty which those of late use have been subject to, for the purpose of navigating all kinds of ships or vessels."

A.D. 1788, August 12.—No. 1663.—McCulloch, Kenneth.—"A mariner's compass on a new construction." An "azimuth compass" is described and shown, in which gimbals are dispensed with. The "compass vessell" is supported on a pivot at its centre of gravity, which is brought as near as possible to that of the needle; the needle moves upon a point "a small distance above the centre of gravity," and near to ~~the centre of motion~~ on which the compass vessel is free to move. For this purpose the bottom of the compass vessel "rises in a conical form," is supported upon a "prop," free to turn in the outer case of the instrument, and has a "ring of lead" round its bottom "to balance" it; two arms, with slits, in which "pivets" are free to traverse up and down, spring from the prop and turn with it when necessary; the pivots are fixed to the compass vessel "in a line with the thin metal plate on which the pivot of the needle rests." The needle is "bent so that the point of the pivot" "is a small distance above the centre of gravity." Besides the above, the compass is fitted with an azimuth circle round the edge of the card, a nonius stop with a slide passing through one of the pivots, a metal bar carrying a magnifying glass to read the divisions of the azimuth circle, and "sight vaines." A "steering compass," on the same principle as the azimuth compass, is described and shown, having the arms with slits, and the prop screwed into the outer case. Another compass is described and shown. The compass vessel is supported by "jimbals," and the inverted cone in which the needle pivot rests has a weight attached to it mounted in small "jambols." The smaller jambols are supported by standards rising from the bottom of the compass vessel. In this compass all the centres of motion are as nearly as possible in "the same horizontal plain."

A.D. 1791, July 5.—No. 1815.—Wright, Gabriel.—A new method of making mariners' compasses. A "gimbel compass" is described and shown, in which the "inside compass box or kettle," made of wood, or any metal except iron, has "a ring of lead" fastened "on the outside and near the centre of motion, "to balance" it. "A metal pedestal" is fixed on the centre of the bottom of the compass box, to which various "pillars or points" "are screwed on and off at pleasure, being all at different times made use of to carry or suspend the magnetic needle and cards. A "hollow metal cone," with a point at the top to receive the needle, is generally placed on the pillar or point screwed into the pedestal; the needle may, however, be placed on the pillar without the hollow cone. Three different "pillars or centres" are described and shown; one with a point to receive the needle; another "with a round top" to receive the hollow cone; and a third with an "agat cap" and gimbals. The needle may either be mounted with a reversible "agat cap," which is kept in its place in a "cylindric brass box" by a helical spring, or it may have an adjustable inverted steel point mounted with a helical spring in a brass box; this last is used with the "gimbel centre." The above compass, cards, and needle, are used in the azimuth, amplitude, steering, and hanging compasses; also in "the conical compass with the new invented semicircle to

prevent its turning round horizontally on its centre or prop." The azimuth compass has the following observable points:—On its card are drawn "a number of lines" "parallel to those usually drawn through the centre," "quite across from the divisions on one side to those opposite." A metal circle, semicircle, or quadrant, having a jointed index moving from the centre, with a vernier; this "may either be made fast to the brass ring or cover of the compass, or made use of detached, having a handle to fasten to it for the last-mentioned purpose." "One or two sight vanes." "On the plane of the circle, semicircle, or quadrant, is placed one or two metal frames, which contain reflecting plain mirrors," "to show the horizon of the line by which means the compass is kept in a horizontal position by the marine horizon."

A.D. 1792, June 19.—No. 1891.—Fullarton, William.—"Certain new methods of separating iron from iron stones and other ores of that metal, of smelting it into the state of pig or cast iron, and of reducing or refining it into the state of malleable or forged iron." The ores are first to be "reduced into a pulverized state," "previously calcining the material when necessary," "and passing the same through sieves or bolters." Then the extraneous matters are separated "by all or any of the following operations (namely,) by washing, levigating, triturating, wennowing, *and by the application of magnetic attraction*, according to the nature and qualities of the different stones and ores." The materials thus purified are to be put into a furnace. A furnace, "to act as a crucible," is described, also the method of using it in this invention, for which it is used in preference to any other kind of furnace.

A.D. 1794, March 18.—No. 1980.—Nugent, Patrick Rooney.—"Two instruments whereby the latitude, longitude and magnetic variation at sea or on shore may be obtained." "An universal reflecting sextant, oxtant, or quadrant," "a glass tubb and bubble," and "a pendulum for taking altitudes without an horizon," are described, and their use elucidated. "A steering or universal azimuth compass" is described, with "an aperture of 45° horizontal width," "cut out of the side of the kettle," half on each side of its shoulders or axis. "Immediately above them" are "two plain sights," firmly fixed so that their central hairs are "exactly opposite to the north and south points "of the card or needle." The apertures "are to be glazed with glass or ising-glass." A method of finding the magnetic variation by this compass is given.

A.D. 1796; January 19.—No. 2081.—Wright, Gabriel.—An azimuth and amplitude compass is described and shown, in which the following additions are made, "by which any one person, without assistance, is enabled to take the azimuth of all celestial objects and their altitudes at the same time, and in every latitude or altitude of the object." A "reflecting octant" fastened on to the top rim of the compass, "in a vertical position," by screws. A "reflecting speculum," and adjustable convex lens, mounted in a sliding tube, used to reflect and magnify the divisions on the card and nonius "in a horizontal view, to be read off by the observer at the time of observation without any personal assistance." A "jointed sight vane with a silk line" to "observe by the sun's shaddow;" also a sight vane with dark glass for taking the azimuth. A method of stopping the compass card by the action of two parallel "bent levers or bridles," one end of which "screws on to the nonius piece," and the other on to an open stop piece on the opposite side of the card; thus, by pressing a nut connected with the nonius piece, the levers cause the card to be pressed in two opposite directions, and stop it without error. An "artificial horizon" to be used with the octant, a "dial and index" "to shew the ship's run during the interval of time in making two observations of the sun's azimuth and altitude," a "screw," with an "index" and "scale" used with the dial, and a scale and quadrant made use of for solving nautical problems, are also described and shown.

A.D. 1798, March 10.—No. 2221.—Perkins, Benjamin Douglas.—The title of this invention is as follows:—"Discovery of a certain art of relieving and curing a variety of aches, pains, and diseases in the human body, by drawing over the parts affected, or those contiguous thereto, in certain directions, various pointed metals, which, from the affinity they have with the offending matter, or from some other cause, extract or draw out the same, and thus cure the patient." The invention consists in employing those metals "which produce that action on the nerves and muscles of animals known by the term galvanism." "Combinations of copper, zink, and a small proportion of gold, and also iron united to a very small proportion of silver or platina," are found most efficacious. Instruments are made with points, which are applied "to those parts of the body which are affected with disease," and drawn "off on the skin to a considerable distance from the complaint, and usually towards the extremities." "The diseases most readily cured by this metallic influence are rheumatism, gout, pleurisy, inflammation, spasmodic affections, and most kinds of topical complaints. All parts of the body on which the metals are to be used, as well as the metals themselves, should be perfectly free from oily and greasy applications. The relief from this metallic application" takes place in from fifteen minutes to "several weeks," according to the nature of the disease.

A.D. 1798, June 27.—No. 2246.—Nugent, Patrick Rooney.—"New invented and improved mathematical instruments, whereby the latitude and longitude, variation and inclination of the magnetic needle at sea and on shore, may be obtained in a more general, masterly, and perfect manner than hath hitherto been done."

A.D. 1798, December 17.—No. 2280.—Peckham, John Randall.—"A new and improved method of constructing a watch so as to unite it with a mariner's compass, in such a manner as to answer every purpose with equal accuracy and perfection for which either of them might be separately used." "My method of constructing a watch so as to admit the uniting it with a mariner's compass, in such manner that the works of the watch shall not affect the magnetic needle nor be affected by it, is this:—I substitute for those works which are usually made of steel, and which are near enough to affect in the smallest degree the free action of the magnetic needle, works made of gold, silver, or any other metal or admixture of metals which have no influence on the magnetic needle, (that is to say) in all cases (whether the mariner's compass be inserted in or upon the face of the dial in any part, or in any part of the back of the watch, either in the box or case), for the following parts usually made of steel (viz.), the barrel, arbor, cannon, pinions, ratchets, and clicks, bolt, bolt spring, detant work, stopworks, cap, spring, and screws, and for every article or part where steel is not absolutely required, I substitute gold, silver, or some other metals or admixture of metals, as above-mentioned."

A.D. 1805, October 7.—No 2883.—Syeds, John.—"An improved steering amplitude or azimuth compass." A compass is described and shown, in which "the outside gimboal" is taken away, and the kettle is suspended on pivots in the "betical" [binnacle?], with or without a wood box; the pivots on which the kettle is suspended prevent the pitching of the ship from affecting the needle. To prevent the needle from being affected by the rolling of the vessel, "a half gimbol," to which the needle centre is fixed, is suspended inside the kettle on pivots at right angles to those suspending the kettle, thus giving four suspending points to prevent the card from being disturbed by the motion of the ship. In this compass the "lubbard's point" [lubber's line?] is marked on the half gimbal, and is therefore not obscured by a side light when the ship is rolling. The amplitude compass is the same as the steering compass, except that it has pins to receive sight vanes, and a deeper cover. An azimuth compass is also described, in which there is "a spring to the nonius and a trigger," to which is fixed a thread for the observer to stop the compass card by; there is a drawing evidently showing this, but not referred to in the specification. To keep the azimuth compass from wear, when not in use, there is "a notch in the standards to place the suspending pivot into when wanted for use, and to take it therefrom and place the compass in the bottom of the box when not wanted to be used." A "scale," to work various nautical problems connected with the ship's course, is also described and shown in detail.

A.D. 1809, September 26.—No. 3265.—Smith, Egerton, and Harris, Michael.—"Certain improvements in ships' binacles and compasses, and in the mode of lighting the same." This invention, called "The patent tell-tale binacle and compass," consists in the following improvements:—1st. The compass is visible on deck and in the cabin "at the same time." 2nd. The compass is illuminated by the same light which lights the cabin. 3rd. Preventing the compass card from being unshipped. 4th. "In enabling the mariner to steer with one compass only," and a small binnacle. 5th. In "darkening the binacle," so "that whilst the compass is distinctly visible," "no light shews" "to an enemy." These improvements are effected as follows:—"The compass bowl is open at the top and bottom. The compass card is of "paper, parchment, silk, cloth, with or without talk" [talc?], "glass, or other proper substance, printed on both sides;" or "a card of metal, with either the points or the interstices cut out, and the spaces filled up with paper, printed or plain, pasted over its whole surface," may be used. "Two card faces" may be pasted together, "with their faces outwards," or an impression may be taken from the engraving, having a sheet of transfer paper on the side of the card

not printed on by the block. To load the card, it is stretched upon two metal rims, rivetted, one on the upper, the other on the under surface. The card centre is supported either on a bar fixed across the bottom of the compass bowl, or fixed into a hole in the lower glass by a screw and nut. Another bar, with a wire projecting into the hollow top of the needle cap, is fixed across the top of the compass bowl, which prevents the card being unshipped. The light is admitted from the cabin by openings in the deck, binnacle, and compass box. A "slide" is placed in the binnacle, "just above the compass box," to exclude unnecessary light. The invention is applied to compasses of the usual construction, by reflecting the light from below to the face of the compass by a mirror.

CORRESPONDENCE.

MR. BRITTAN'S PLAN OF COMMUNICATION BETWEEN GUARDS AND ENGINE DRIVERS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I am not in possession of the date when Mr. Brittan published his plan for effecting communication between the guard of a railway train and its engine-driver, but I find a plan suggested in the pages of the Mechanics' Magazine for September, 1847, which appears to me to embrace that proposed by Mr. Brittan.—Yours, &c., TYRO.

"Let there be fixed upon the roof of every carriage a small staff, moving on a fulcrum, with a flag attached to the long arm thereof; and from the short arm let a wire or rope be carried into every compartment of the carriage, to act as a bell-rope; so that, in case of accident or illness, the passengers, by pulling in the rope, could raise the flag-staff perpendicularly from its horizontal position, thereby giving a signal of danger to the guards. For night signals, the ordinary lamp of the carriage would be substituted for the flag. And for effecting a communication between the guards and the engine driver, I would suggest the following simple and inexpensive means:—Let a small lead, tin, or copper tube be laid the whole length of every carriage; and for connecting the tubes between the carriages, so as to form a continuous tube the whole length of the train, I would have a piece of India-rubber tubing inlaid with a spiral spring. One end of the long tube would be fixed to the steam pipe, so that a jet of steam could be made to traverse the whole length thereof, and escape at the distant end. At the seat of every guard a stop-cock would be fixed in the tube, so that he could, on perceiving a signal of danger, stop the current of steam, which would then ascend a branch pipe furnished with a whistle, near the engine driver, and cause the same to sound, or remove a detent from a bell machinery. This tube would, in the case of a carriage running off the rails, or becoming detached, be self-acting; for the elongation and consequent collapsing of the India-rubber and the spiral spring, would stop the current as effectually as the "*stop-cock*," and cause the same result. Arrangements in connection with the engine could be made to cause a current of air to traverse the tube in substitution for steam, if it were more desirable—the intersecting tubes of India-rubber, &c., could be instantly attached and detached by the adoption of slides, &c.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I do not agree with your correspondent, R. S. Culley, that the plan of signalling proposed by Mr. Brittan, by having a whistle on the roof of the guards' van, worked by compressed air, would in the least *weaken the significance* of the engine whistle. The sound emitted by the guards' whistle would be quite different to that of the engine. As a practical engineer, I think that Mr. Brittan's plan is a very good one, and could be relied upon. It is very desirable that some such plan should be adopted, as there can be no question but that many serious accidents would be averted, thereby increasing the public confidence in railway travelling, which has of late been seriously affected. There have been, within the last few weeks, about twenty patents taken out for improved means of effecting the object in question; of their merits I cannot speak, as they have not yet been specified. However, my opinion is that no arrangement will be adopted until a director, a bishop, or a prime minister, as predicted by the late Sydney Smith, is sacrificed in consequence of the absence of the means of communicating the existence of danger. In the papers of this day an account is given of one of the carriages in a train having taken fire, to the great terror and danger of its occupiers, who possessed no means of averting the progress of the train. Yours obediently, A DRIVER.

13th October.

THE NEW ATLANTIC CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It appears to me somewhat strange that the Directors of the Atlantic Telegraph Company should involve the shareholders in a second expense of testing specimens of cables after what had been done under the direction of the Telegraph Committee of the Board of Trade, of which the company's chairman, engineer, electrician, and secretary were members. Several lengths of a cable, constructed upon the same principle as the one now adopted, and manufactured by the same parties, was considered the worst adapted rope for deep-sea purposes of all those subjected to experimental test, from its liability to kink, and its enormous elongation when weighted, and the return or contractibility on the removal of the weight forcing the core out clean between the strands, as appears from a sketch in the Committee's Report. Yet Mr. Fairbairn, who was a member of that committee, and whose signature is appended to the report, has actually recommended the adoption of such a cable, although when challenged by Captain Selwyn as to the correctness of its mechanical construction, at the late meeting of the British Association at Bath, Mr. Fairbairn admitted the soundness of the gallant Captain's objections. Captain Selwyn objected to "a spiral covering combined with a straight internal wire, as incompatible with security from disruption," and Mr. Hawkshaw an engineer of great experience, said at the same meeting "no one would dispute that Captain Selwyn was right in principle." PROGRESS.

[The subject towards which our correspondent calls attention is certainly one of great importance. The selection of a cable constructed upon principles which have in every instance failed in practice is inexplicable to us.—ED. *T. J.*]

TELEGRAPHIC NEWS.

WEST HAM GUTTA-PERCHA COMPANY.—This company's premises being required for metropolitan improvements, arrangements have been effected whereby its interests will be united to those of "the India-rubber, Gutta-percha, and Telegraph Works Company, Limited."

THE ELECTRIC TELEGRAPH IN INDIA.—The Indian telegraphic lines are being rapidly extended, but great complaint is heard of the delay in the transmission of messages. The Indian Government is urged to surrender the management of these lines to some public company. The Oriental Telegraph Company has made an offer to work them.

IRREGULARITIES ON THE INDIAN TELEGRAPH LINES.—By advices per the last mail from Bombay, we learn that "a commission is to be appointed to investigate the causes and origin of the great irregularities in the working of telegraphic communication throughout India, and to examine into the efficiency of all the officers and employés connected with the department."

TELEGRAPHY ON THE CONTINENT.—Tourists will be glad to learn that the Brocken, the highest mountain of the Hartz Mountains, will be, by next spring, connected with Ilsenburg, thus enabling them [tourists] to ascertain the state of the weather, the friends they are likely to meet there, and the nature of the accommodation they can expect.

SHOCK OF EARTHQUAKE AT GWADUR.—A smart shock of earthquake was felt at Gwadur, on the Mekran coast, on the 25th August, but it did not do any serious mischief. The wave passed from north to south. Portions of the ledges of the Mekran and Gwadur mountains were thrown down with a tremendous crash.

THE ELECTRIC AND INTERNATIONAL TELEGRAPH COMPANY.—At a meeting of the General Purposes Committee of the City of London, Mr. Cromwell Varley, electrician to the Company, applied for permission to be allowed to lay down a pneumatic tube of two inches diameter, for the transmission of telegrams, from the Company's office, in Telegraph-street, to the offices of the British and Irish Magnetic Telegraph Company in Threadneedle-street. The permission was immediately granted by the Court.

THE ORAN AND CARTHAGENA CABLE.—The *Sentinelle Toulonnaise* announces that "the submarine telegraph cable which was laid successfully between Oran and Carthagena, remained perfect only four hours, having become broken at a point supposed to be but a few miles distant from the Spanish coast. We are assured by several gentlemen well acquainted with the shores of the Mediterranean, that it will be impossible to manufacture a telegraphic cable sufficiently strong to resist the destructive influence of the reefs and submarine currents."

NEW GAS LIGHTING APPARATUS.—Mr. T. C. Ebdy and Mr. M. Burdon, of Durham, have brought out an apparatus for lighting gas, intended to obviate the necessity of its being done by hand. It is called the "electro-magnetic gas-lighting apparatus." The invention may be applied to any description of gas-lamp, without their requiring alteration. The apparatus is about three times the size of a lady's thimble, and very much like an ordinary gas-burner. The principles upon which it is based are stated as follows:—An ordinary telegraph wire, communicating with the negative pole of a galvanic battery, is connected with the electro-magnetic burners in succession, according to the number of lights required, and the extremity of the wire communicates with the earth, or is conducted back to the battery, and attached to the positive pole, when the circuit is complete. Therefore, to light and extinguish the lights, it is only requisite to connect or disconnect one of the poles of the battery. Immediately the current enters the electro-magnetic burner it passes through an insulated wire, which is wrapped round a soft iron tube, which immediately becomes a powerful magnet, and attracts a piece of soft iron, which opens a kind of valve and permits the gas to escape through the burner; at the same time the gas-valve is opened, the current passes through a piece of platinum wire close to the burner, which turns red hot and lights the gas. This effect is produced at every burner at the same instant.

Malta and Alexandria Cable.—The Fanny Lambert, screw steamer, returned to Malta on the 30th September, from her successful mission to repair the ruptured cable between Benghazi and Alexandria, some 140 miles from this latter port, which, after a lapse of twenty days, is again in working order. The defect did not, however, result to be where it was expected to be found, and where weakness is known to exist, so that it is more than likely we may have before long to deplore another like temporary interruption. The Fanny Lambert has been ashore on the Barbary coast, where some of the blades of her propeller got broken off, and she also sustained some trifling damage in her bottom, which luckily is a double one, for the repair of which damage, and in order to be fitted with a new propeller, she was taken into the government dock on the 1st of October.

The Indo-European Telegraph.—The *Scindian* learns that all messages between the home and Indian government will be transmitted in duplicate, one copy by the Persian Gulf, the other by Suez, as there are evidently good reasons for this precaution. The first, it secures messages against the muddle into which the process of transmitting them in Turkish, as stipulated by the Porte, must throw them; and, second, to avert total or complete miscarriage, in consequence of interruptions on the wire through Mesopotamia, or the cable down the Gulf. The line running through the Montific country, when completed, can scarcely be depended upon, owing to the relation existing between the tribes, very powerful and warlike ones, and the Pasha of Bagdad, against whom these people have risen in rebellion. This insurrection, which promises to be a protracted one, would not affect our position in these parts if we were permitted to use European and Arab workmen on the line, but the present Governor of Bagdad will consent to none but Turks being employed, and these the Arabs will assail whenever they can get a chance. The British government is also well aware of the frequency with which these difficulties between the Montific and Turkish authorities occur, that they were led, last October, to enter into treaty with others for the construction, by the latter power, of a line which shall effect a considerable detour, to avoid the disturbed district completely. This wire is to pass from Bushire, on the Persian Gulf, where the cable lands before starting 170 miles further, to its terminus at Shat-el-Arab, *viâ* Kazeeroor, Shiraz, Movighaut, Kormshah, Ispahan, Kashar, Korm, Teheran, Hamadan, Kermanshah, and Khanakeen, to Bagdad, the distance between Bushire and Khanakeen being about 1,100 miles. A glance at the map will show what a vast circuit has to be made to keep clear of the country which it takes only about 360 miles of wire to traverse. We are in hope to hear, however, that the work on the Persian line is being pushed on with so much energy that its completion is looked for shortly. We hope by the time this is done the cable beyond Gwadur will have been put to order. Should, however, submarine communication unfortunately turn out to be uncertain, it may become desirable to find a *route* for the wire from Shiraz to Gwadur. The country, we are aware is rather unsafe between these points, and much of it is a desert; but diplomacy must accomplish beneficial results with the tribes which dwell in it, whilst, no doubt, the impracticable spot could be avoided.

Military Balloon Signals.—The following communication appeared in the morning journals of the 10th instant. Electrical communications between the balloon and terra firma have frequently been successfully effected in the American armies. "The employment of telegraphic signals on the occasion of my recent ascent from the Crystal Palace has, I am glad to say, created some interest among military and scientific men. Just about ten years ago, when I suggested the use of reconnoitring balloons in the Crimea, I devised and experimented with a set of semaphore signals. I then ascertained that they could be easily worked, and that their action could be seen and understood by observers in possession of their meaning. From communications I have received since September 22, it appears that for ten miles in a south-west, south, and easterly direction, the signals, with the aid of glasses, could be distinctly seen; and, although on this afternoon they were merely set in motion without any definite meaning, still it is satisfactory to learn that ærial telegraphy can be made the medium of imparting valuable information either to the inhabitants of a large area or, if necessary, to the select few who may alone have the key to their import. For, example, if used for scientific purposes—say, as an ærial observatory to announce the time of day. This could be accomplished by the dropping of a huge black ball down a rope a few hundred feet long. By this means a numerous population could have a visible intimation of the exact hour, or of any other subjects of which simultaneous observations are desirable. But more especially, I believe, for military signals would the idea prove worthy of adoption. A balloon, just as I used mine for government experiments at Aldershot and the Arsenal, could be let up with ropes, kite-fashion, and the signals set in motion, either to direct the evolutions of an army, or to convey secret intelligence to the commander-in-chief. For reconnoitring during a battle there is no real necessity for risking the destruction of the balloon, as a mile or two from the car, at a very moderate elevation, appears almost close, and signal-arms of twenty feet in length, such as I use, can be discerned many miles away with the naked eye. It might prove of importance, in case of invasion, or the threat of it, to have the telescopic range of the southern and eastern portions of our island from stated heights up to several thousand feet; also to know from stations on our coast what amount of ocular acquaintance could be made with our neighbours' sea-board. This would be a good test for our most approved instruments, and would certainly aid military as well as scientific ballooning. —Henry Coxwell."

The British Association.—At the meeting of the above association at Bath, Admiral Sir E. Belcher read a communication from Captain Doty, of the Confederate States Navy, "On the Torpedoes used by the Confederate States in the Destruction of some of the Federal Ships of War, and the Mode of attaching them to the Rams." The torpedo consists of a shell filled with explosive material, whether gunpowder or gun-cotton, and is carried under the surface of the water at the end of a bar attached to the stern of the ram or other vessel, projecting some ten or twelve feet. The bar has a slight sliding motion, by means of which the end of the bar within the vessel, as soon as the torpedo strikes the enemy's ship, acts on a simple mechanical arrangement, bringing the wires connected with the torpedo into circuit with a galvanic battery, causing the explosion of the shell. Such an engine of war, Captain Doty states, having been attached to small wooden steamers, an attack was made by it against the Federal frigates, New Ironsides and Minnesota, and so much damaged them by the explosion as to render them unfit for further effective service, till docked for repairs. It was also employed in like manner against the new sloop-of-war, Housatonic, attached to the Federal blockading squadron off Charleston, which ship filled, and went down in eight minutes after the explosion of the torpedo under her counter. It is unhesitatingly asserted, by competent judges, that a vessel properly constructed for the use and application of the torpedo battery, and possessing superiority of speed, would prove a formidable antagonist against a number of frigates, armed with the heaviest metal, for it would, by advancing end on, present the least surface to their fire, and always under the most acute angles. An especial advantage which it possesses is, that it may be worked at all times; for instance, in a rough sea, when ordinary guns could not be used, while it may be employed with certain success, under cover of darkness, against an enemy's fleet, destroying, disabling, or driving them away from the coast altogether. Great economy, simplicity, and safety are, further, among the valuable and important qualities claimed for the submarine battery; neither the battery itself, nor the men working it, are in the least exposed, the apparatus being situated much below the line of flotation. Admiral Belcher proceeded to point out the superiority of such an engine of warfare over rams. A ram with a velocity of 10 knots overhauls and touches the stern of the vessel she chases, going at the rate of 9½ knots—a half-knot velocity would not injure her opponent, although it might impair her steerage, and bring her broadside to operate on her, in all probability, at such close quarters, to her detriment. But a ram fitted with the means of projecting a simple shell under the counter, or into contact with the screw, would inevitably destroy, or at least so derange rudder and screw that her great work of executing the ram manœuvre at right angles to her antagonist would no longer be matter of doubt; and surrender would, under such difficulty, doubtless result. The French and other foreign governments have approved of the plans of Capt. Doty. Our own Government ordered the examination of them by a scientific committee, and it has expressed approbation in an official communication.

Anglo-Indian Telegraph.—Sir Charles Bright writes the *Times* of the 9th instant as follows:—"It will interest those who have watched the progress of our telegraphic communication with the East to know that the injury to the telegraph cable, in the shallow water on the Mekran coast, lately reported in your Indian news, has been repaired. A telegram has been received by Sir Charles Wood, from Colonel Stewart at Constantinople, dated the 7th instant, conveying the substance of a message from Colonel Kemball, at Bagdad, of the 3rd instant, reporting the reinstatement of telegraphic communication between Bussorah and Kurrachee, and announcing the receipt at Bagdad of a telegram from India, dated the 27th September. The line from Bagdad to Hillah, and thence to Diwanyeh, on the Euphrates, is completed, but between the latter point and Korneh, where the Tigris and Euphrates unite with the Shat-el-Arab, there remain yet to be finished 160 miles of land telegraph to complete our through telegraphic communication with India. The Euphrates has ceased to be a navigable river for some years through the banks being neglected, and thus, until the land line is completed, the only communication between Bagdad and Bussora is by way of the Tigris, by the British-armed steamer, Comet, two Turkish steamers, and a steamer belonging to Messrs. Lynch, of Bagdad, which run regularly up and down the river; another steamer was about to be placed on the river, when I was there in May last, but I am not sure whether this has been done. The passage up the river, including stoppages for taking in wood, occupies from five to six days, according to the state of the river, the passage down the river being done in two days and a-half; this will account for messages of the 27th ultimo from India being reported on the 3rd instant. The delay between Bagdad and Constantinople, from the 3rd to the 7th of October, is owing to the temporary interruption of the land line passing through Mossul, Diarbekir, Sivas, and Angora. Another route from England to India, in connexion with the Persian Gulf cable, passes through Russia by way of Tiflis to Teheran, thence to Ispahan and Shiraz, and joins the cable at Bushire. The whole of this length will be completed in a few weeks. We shall then have two distinct routes to India —one by way of Turkey, the other through Russia. The Indian telegraphs, which connect together Calcutta, Bombay, Madras, Delhi, and all the principal towns in India, are now advanced eastwards as far as Rangoon, and the routes thence to China and to Australia, by way of Singapore, Java, and Timor, are almost entirely in comparatively shallow water, so far as the submarine part of the line is concerned, and do not otherwise offer any difficulty which should prevent our having daily telegrams from Hong Kong,

Melbourne, Sydney, Adelaide, and Brisbane, within three years from this date."—On the 12th instant, "C," an anonymous correspondent of the *Times*, thus comments on the foregoing communication :—"In a letter in the *Times*, signed 'Charles T. Bright,' I read the following paragraph, very strange, indeed, as coming from a professional engineer of long experience:—'The Indian telegraphs, which connect together Calcutta, Bombay, Madras, Delhi, and all the principal towns in India, are now advanced eastwards as far as Rangoon, and the routes thence to China and Australia, by way of Singapore, Java, and Timor, are almost entirely in comparatively shallow water, so far as the submarine part of the line is concerned, and do not otherwise offer any difficulty which should prevent our having daily telegrams from Hong Kong, Melbourne, Sydney, Adelaide, and Brisbane, within three years from this date.' Now, in my opinion, it would be difficult to comprise a greater amount of error in so small a compass than is contained in this short passage. The engineer, it is certain, has been drawing most abundantly on his imagination, and I fully expect to find him, by and by, promising to waft daily 'sighs from India to the Pole.' It is true that telegraphic communication has been established over India, and that it extends as far as Rangoon, but not a foot of this is submarine; all is by land save the passage of rivers. The sphere of our engineer's project, reckoning from Rangoon, extends over 60·50 degrees of latitude and about as much of longitude; but this is far from conveying an adequate notion of the grandeur of the scheme. From Rangoon to Singapore the distance is about 1,000 miles. If the telegraph in this case be by land it will be carried through an almost uninhabited jungle, and over the country of five independent and rather barbarous princes; if by sea, the cable will be laid for the most part in a coral bottom. From Singapore to Hong Kong the distance is about 1,500 miles, or about three-fourths of the breadth of the Atlantic, and here the telegraph throughout must be submarine, and not in a comparatively shallow sea, but in one of very considerable depths, vexed by typhoons and with hardly a resting-place. If we turn to the remaining part of our engineer's project, the difficulties are incomparably greater. From Singapore to Batavia the distance is about 650 miles, and the sea is shallow enough; but then it has a coral bottom nearly throughout. The Dutch laid a cable here about three years since, which conveyed a few messages for a day or two, when it broke through the friction occasioned by the ever uneven coral bottom. It was repaired and it broke, and this over and over again, and the Dutch have given up the project as impracticable. From Batavia by Timor to Cape York, in Australia, the nearest occupied point of the continent, the distance may be computed at 2,500 miles, or by one-fourth greater than the breadth of the Atlantic between Ireland and Newfoundland. This is not a shallow sea, but, on the contrary, considered by experienced mariners, one of the very deepest in the world. I have not yet quite done with your 'poetical engineer,' although the easiest part of his task only remains for consideration. This consists in carrying a land wire from Cape York by Brisbane, Sydney, and Melbourne to Adelaide. The distance here cannot exceed 2,500 miles, or about twice as far as from Calcutta to Lahore, and there will be nothing to interfere with this part of the line, unless now and then a savage, ambitious of adorning himself or his squaw with a bit of wire, or pointing his arrow with a fragment of iron. To sum up, your imaginative 'engineer' will have to lay down sometimes among coral reefs, and sometimes in unfathomed sea, some 5,000 miles of submarine cable, and 2,500 of land wire, making in all a telegraphic line of between 7,000 and 8,000 miles long."

MISCELLANEA.

Gas Lighting by Electricity.—At the Bath meeting of the British Association, Professor W. B. Rogers, of Boston, Massachusetts, exhibited a novel arrangement for lighting a gas-burner, or many gas-burners, by an electric spark, formed by drawing out a stopper of vulcanized iron. The friction sends a current sufficiently strong for the purpose.

French Rewards of Genius.—A few weeks since we announced that M. Rhumkorf had received the prize of 50,000 francs, offered by the Emperor Napoleon, for his induction coil. Honours are being freely bestowed in France, and among other tributes to genius we may mention that Mr. Sorel has been awarded the prize of the Marquis d'Argenteuil for his invention of the process of zincing iron, an operation better known as galvanizing iron.

British Capital.—From the Board of Trade returns we gather that the miscellaneous companies, such as telegraph, steamship, discount, financial, or others—all, or nearly all, of which are "limited," and of recent creation—have absorbed a paid-up capital of £37,000,000 sterling.

Payment of Dividends out of Capital.—Baron Martin said, in a recent case tried at the Guildford Assizes, "The law directs that directors may, with the sanction of the company, in general meeting assembled, declare a dividend to be paid to the shareholders, in proportion to their shares; but no dividend should be payable except out of the profits arising from the business of the company; and therefore it is the bounden duty of the directors—indeed, I do not believe that the shareholders could legally, make a dividend, for it is the directors who are to make it—it is their bounden duty, if a dividend is declared otherwise than out of profits, to refuse to pay it, and, if necessary, to appeal to the Court of Chancery to restrain its payment."

The Continuance of Parliament.—The present Parliament was "begun and holden on the 21st May, 1859," and will not legally expire until the close of next year. The last was the sixth session, and, as Parliament is septennial, "seven" can be holden. According to the usual practice, the dissolution will take place next spring, when we hope the friends of telegraphy will bestir themselves, and secure the election of some qualified representative of their interests in Parliament.

To Varnish Articles of Iron and Steel.—Dissolve ten parts of clear grains of mastic, five parts of camphor, fifteen parts of sandarach, and five of elemi, in a sufficient quantity of alcohol, and apply this varnish without heat. The articles will not only be preserved from rust, but the varnish will retain its transparency, and the metallic brilliancy of the articles will not be obscured.

The Electric Light.—At the Royal Institution ten years ago, Dr. Frankland gave a sketch of the condition of artificial lighting. Since that period but little progress has been made towards perfecting those processes of producing artificial light at that time in general use. Nevertheless, the improvements effected in the production and application of the electric light, the increase of our knowledge both of solar and terrestial light, and especially the discovery of an entirely new illuminating agent, threatening to produce a revolution in lighting almost equal to that which was the result of the invention of gas—rendered it desirable for the author again to review this subject after the lapse of a decade. In glancing at the improvements effected in the different departments of artificial illumination, those which relate to the electric light were first noticed. The electric light is produced by the interruption of an electric current flowing through good conductors; by this interruption the current is made to leap across a space provided in its circuit. The boundaries of this space, in the ordinary electric light, are formed by two portions of gas carbon, and during the passage of the electric current across it, the two pieces of carbon are heated to a most intense degree, and far beyond that produced by any other means at our disposal. The great source of illuminating power was shown to be the ignited ends of these two pieces of gas carbon, and not the space between them. Such being the nature of the electric light, the principal improvement which has been effected in it, during the past ten years, consists in the production of the electric current through the intervention of heat and mechanical force, by what is termed magneto-electricity. More than thirty years ago, Mr. Faraday produced a spark from the ordinary permanent magnet. Here, said the speaker (producing a magnet) is the very cradle of this magneto-electric light, and this is the very magnet with which Mr. Faraday operated. This improvement constitutes one of the greatest steps in advance which have been made in the application and production of the electric light. By the combustion of coal a certain amount of mechanical power is obtained, which is applied to the rotation of masses of iron in the neighbourhood of very powerful permanent magnets. In this way, currents of electricity are produced, and these are thrown together, and made to circulate through a system of conductors: in fact there is no difference, as regards the effect at the carbon-prisms, between the action of this magneto-electric current, and the ordinary electric current produced by the chemical action which takes place in the voltaic battery. But this improved mode of producing the electric force demands less manual labour; the mechanical work being performed by a steam engine, which causes the rotation of the armatures. This magneto-electric apparatus, as perfected by Mr. Holmes, has now been in use for upwards of two years in the South Foreland and Dungeness lighthouses, where, as well as in other similar beacons, the production of a light of the greatest intensity is of the greatest importance to the mariner. During this time it has performed its office remarkably well, and without a single instance of failure; thus proving itself well adapted for the purposes of lighthouse illumination. For domestic light it has not yet been brought into use; its expense, doubtless, at the present moment, being far too great to admit of its being employed in this way: but where a light of great intensity, regardless almost of the question of expense, is required, as in the case of lighthouses, this magneto-electric light can scarcely be too much prized. The speaker also described the mercurial electric light, but considered it inferior both in brilliancy and steadiness to that procured by the passage of the electric current between carbon terminals. More than thirty years ago, Mr. Faraday pointed out a source of the electric light in the permanent magnet; but we are only now beginning to use it for illuminating purposes. The brilliant little spark was long looked upon as a mere scientific curiosity, and is only now beginning to flash across the sea, guiding the mariner safely into harbour, or warning him from approaching a dangerous coast. How long will thermo-electricity have to wait before it receives a similar application? In thermo-electricity we have a direct transformation of the force of heat which we obtain with such great economy from coal, into an electric current, and this, by further education and development, might be rendered available in the production of the electric light. Hitherto, its application in this direction has been altogether unheeded, and yet of all sources of the power necessary for the electric light, thermo-electricity evokes this power most directly from coal. In the magneto-electric light we have the great disadvantage, that the heat of burning coal must be first transformed into mechanical power, which is made to rotate the armatures of magnets, and thus produce the necessary electric current. In this transformation of heat into mechanical power there is no less than $\frac{9}{10}$ths of the original force in the coal absolutely lost. Hence the advantage which would result from the direct application of heat to the production of the electric current.

Investigations on Molecular Physics.—Mr. Warren de la Rue, Mr. Balfour Stewart, and Mr. Loewy, are engaged in a series of important investigations, embracing a variety of interesting views connected with the physics of the sun; these views being derived partly from a discussion of the photographic pictures obtained at Kew, and partly from considerations wholly distinct from the results of photographic observations. Mr. Carrington has, also, recently placed at the disposal of these gentlemen his observations made at Red Hill, during a period of seven years. It is expected that some light may thus be thrown on terrestrial meteorology, and possibly also, on molecular physics, by the labours of these ardent workers in science.

Annealing.—In a considerable number of instances, bodies which are capable of undergoing ignition, are rendered hard and brittle by sudden cooling. Glass, cast-iron and steel are the most remarkably affected by this circumstance; the inconveniences arising from which are obviated by cooling them very gradually, and this process is called "annealing." Glass vessels are carried into an oven over the great furnace called the leer, where they are permitted to cool, in a greater or less time, according to their thickness and bulk. Steel is most effectually annealed by making it red-hot in a charcoal fire, which must completely cover it, and be allowed to go out of its own accord. Cast iron, which may require to be annealed in too large a quantity to render the expense of charcoal very agreeable, may be heated in a cinder fire, which must completely envelope and defend the pieces from the air till they are cold. The fire need not be urged so as to produce more than a red heat; a little beyond this, bars and thin pieces would bend if destitute of a solid support; and would even be melted without any vehement degree of heat. If it be required to anneal a number of pieces expeditiously, and the fire is not large enough to take more than one or two of them at once; or if it be thought hazardous to leave the fire to itself, from an apprehension that the heat might increase too much, the following scheme may be adopted: heat as many of the pieces at once as may be convenient, and as soon as they are red-hot bury them in dry sawdust. Cast-iron, when annealed, is less liable to warp by a subsequent partial exposure to moderate degrees of heat than that which has not undergone this operation. The above methods of annealing render cast-iron easy to work, but do not deprive it of its natural character. Cast-iron cutlery is, therefore, stratified with some substance containing oxygen, such as poor iron ores, free from sulphur, and kept in a state little short of fusion for twenty-four hours. It is then found to possess a considerable degree of malleability, and is not unfit for several sorts of nails and edge-tools. Copper forms a remarkable exception to the general rule of annealing. This metal is actually made softer and more flexible by plunging it, when red-hot, into cold water, than by any other means. Gradually cooling produces a contrary effect.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2456. F. Tolhausen, improvements in apparatus for transmitting signals.—A communication.
2461. W. Anderson, improved apparatus for working railway signals.
2463. F. W. Shields, improvements in telegraphic posts.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1720. R. A. Brooman, improvements in batteries and in electric printing telegraphs.—A communication.
2250. W. Chubb and S. Fry, improvements in the means or method of effecting communication between passengers, guards, and engine-drivers of railway trains.
2254. A. Bertsch, improvements in lightning conductors for preventing atmospheric electricity damaging electric telegraph instruments.
2256. M. L. J. Lavater, improvements in the manufacture of driving straps or belting, and of tubes of vulcanized india-rubber, and also in the manufacture of the helical coils of wire commonly inserted in vulcanized india-rubber tubes, also in desulphurizing articles of vulcanized india-rubber.
2260. T. H. Simpson, improvements in printing by electricity for telegraphic and other purposes.
2312. F. Hovenden, improvements in railway signal apparatus.
2341 A. V. Newton, improvements in the mode of and machinery for manufacturing telegraphic cables.—A communication.

PATENT SEALED.

113. J. H. Simpson, certain improvements in printing from type by electricity.

PATENT WHICH HAS BECOME VOID.

2429. M. Theiler, improvements in telegraphs.

NOTICES TO PROCEED.

1405. W. H. Preece, improved domestic telegraphic apparatus.
1412. H. A. Bonneville, improvements in telegraphic printing apparatus.—A communication.
2254. A. Bertsch, improvements in lightning conductors for preventing atmospheric electricity damaging electric telegraph instruments.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/2 to 2/6 per lb.	

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Java and Penang	1/3 to 1/5	,,

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TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph	100	104½ to 105	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	⅜ to ⅝	—
5	United Kingdom Telegraph	3	1 to ½ dis.	—
10	Mediterranean Extension Tel.	all	3 to 3½	—
5	London District Telegraph Co.	all	1 to 2	—
20	Telegraph Maintenance Co.	4	3¾ m.	—

TO CORRESPONDENTS.

L. A.—We have received no reliable information of the failure of the cable you mention.

Une Femme.—1. Yes, a great many. 2. If you possess a good physical constitution. 3. The climate of India is very trying to Europeans generally.

Alfred W.—Try the battery described by Captain Selwyn in No. 40 of our journal.

Utopian.—We must confess to little faith in the statements of persons who affirm that they can convey intelligible signals by means of the electric current without an artificial conductor. When we see we will believe.

Londonensis.—The head offices are situate 58, Threadneedle-street, E.C.

Enquirer.—You will get the work through Messrs. Trübner, the American booksellers, of Paternoster-row.

J. Roberts.—We have heard it reported that the Indian Government intend to employ a large number of female telegraphists, but we are not in possession of any reliable facts relating to the subject at present, although we have made inquiries of several parties connected with Indian and home telegraphy.

Archimedes.—We shall shortly insert a full description of Mr. Preece's electric semaphore. We are informed that the arrangement has answered the purpose well on the line upon which it has been adopted.

Peter I.—We do not think that the plan you suggest for effecting communication between the guard and engine-driver could be successfully applied; it is too complicated, and would be liable to get continually out of order—a very serious defect.

B—t's promised contributions will be most acceptable.

A Constant Reader.—The magnesium wire can be purchased at any of the photographic establishments, we believe, in town or country. It can be had of any length and dimension.

D. M. E.—The engineers of the Persian Gulf line are Messrs. Bright & Clark, of Victoria-street, Westminster.

Experimentalist.—We are not able to furnish you at present with the progress made in the manufacture of balata, but we believe that extensive experiments are being carried on to test its applicability for submarine insulation.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

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The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

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THE TELEGRAPHIC JOURNAL.

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POPULAR NOTIONS OF THE TELEGRAPH.

THE time is not so far distant when it was believed that the electric telegraph was a carrier of goods as well as messages. Every one is familiar with the story of an elderly lady who hung her umbrella on the wires, and expected to see it whisked off to a distant relative. Many laugh at the old lady's simplicity who are equally uninformed of the operations of the telegraph, and who will not give themselves time to make a few inquiries into the laws by which electricity has been made to obey our behests. Professor Faraday declared, "there was a time when I thought I knew something about the matter, but the longer I live, and the more carefully I study the subject, the more convinced I am of my total ignorance of the nature of electricity;" yet this is the agent we employ to run on our errands. Notwithstanding the foregoing confession, which is characteristic of a man who believes that "there are more wonders in heaven and earth than are dreamed of in our philosophy," we do not despair of arriving at conclusions which shall establish the value of electricity as an illuminator and as a motive power, surpassing in its uses to mankind the services of gas and steam. Knowledge has, within the past few years, increased; observation has been strengthened by research; and there is abundant reason to hope that, ere long, discovery and invention will open up new spheres wherein the subtle fluid may be employed advantageously.

Our present object is not to enter upon an exposition of the wonders of science, but rather to note a few of the popular fallacies concerning electricity in its application to telegraphic purposes. A few years ago a leading (?) article appeared in a daily newspaper, which shows at once the ignorance of even journalists, who are supposed to know something of a subject on which they essay to express an opinion. The editor of the paper thus referred to comments on the projected line of telegraph between Dover and Yarmouth in the following strain:—

"It is a fact, which some of our readers may be ignorant of, that sparrows and other small birds which happen to perch on those mysterious lines of communication, the telegraph wires, are destined ever and anon to suffer severe shocks of electricity, the effect of which is (though we never witnessed the phenomenon) that they drop down, not dead, but half dead with amazement and terror. The shock, if severe enough, will destroy them. Electricity can be administered in doses which would kill a horse. Perhaps, by transmitting through the telegraph wire a very powerful charge, the unhappy sparrows along the whole line from London to Yarmouth might be cut off. This, in case of necessity, or as a matter of cruel curiosity, might be employed as a means of getting rid of these vermin. It is not uncommon or extraordinary to see at least a hundred of these feathered depredators on one mile of wire. The length of the whole line of which we speak is 146 miles. A shock strong enough to destroy sparrow-life would, with these data, cut off from the land of the living, at one fell and fatal swoop, not less than 14,600 of these little creatures. One thousand miles of railway would in like manner, with the same conditions, be the death of 100,000. Even supposing that death does not ensue, yet how miserable will be the state of these little animals when the whole island is covered with a veritable network of telegraphic wires! Fatal twigs these for tiny feet! The whole family of sparrows will be paralyzed. The fowls of the air will be electrified. People, as they talk with each other, and whisper to each other in unheard communion, at the distance of 1,000 miles, will be causing serious inconvenience to the feathered race. We tremble to think of the consequences, and heartily recommend the case to the Society for the Prevention of Cruelty to Animals. Dog-carts sink into insignificance when compared with this wholesale palpitation—this universal twittering and consternation—among the feathered tribes. How many a sweet song will be interrupted—how many a little throat silenced—very suddenly indeed, when this mischievous machinery shall be brought into universal play!"

It will be unnecessary at the present date for us to state that this specimen of "leading" literature is founded on an erroneous conception of electrical laws. No bird could be affected in the slightest degree by the electric current if perched on a telegraph wire, unless, as is very improbable, its body was in connection with the earth at the same time. Here we have an exemplification of the folly of the blind leading the blind. This article made many people, equally simple as the writer, "tremble to think of the consequences to the feathered tribe." One of the odd notions entertained by the public on the introduction of the over-house telegraph was, that messages in the course of transit from station to station occasioned a noise as of the humming-bee. A lady, who gave permission to the engineer of the London District Telegraph Company to erect a telegraph pole on the top of her house, subsequently complained to the secretary of the company of the horrid discourse of young men at work on the telegraph in the small hours of the morning, who were described as using language "unfit for any respectable female to listen to." The horrid discourse which so much annoyed this good lady was caused by the wind whistling through the wires and causing their vibration. A less imaginative person could simply hear the humming sound before referred to.

Happily, these erroneous views and prejudices are giving place to a more enlightened conception of the uses of the telegraph; and its importance as a means of communication is daily becoming more apparent. It is not long ago, however, that an individual presented himself at the telegraph-office at Dover one afternoon with a sum of money in his hand, and desired the clerk to send the cash *in propria formâ* up to London by telegraph, to be forwarded to a certain banker's establishment. The money was to take up a bill due that day, and there was no time to send it by train. He seemed perfectly surprised that it could not be sent. At the London terminus of the South-Eastern Railway a servant came to the office heated and out of breath, with a small parcel to be sent by telegraph to a distant part of the country. It appears he had instructions to send it by the train; but he arrived just one minute too late, and as it was of consequence, he thought he could get out of his dilemma and expedite matters by adopting this course. The telegraph is often mentioned as auxiliary to the railway system, and hence possibly the impression evidently entertained by the unfortunate domestic, that it is only when the locomotive is found to be too slow or too fast that the telegraph should be employed. These cases occur but seldom, and if proper means were used by the managers of telegraph companies to disseminate useful information concerning the telegraph—its uses, advantages, and economy—a more general employment of the wires might reasonably be anticipated. All, or at least many, commercial men of the present generation have great faith in the quaint couplet—

"He who in the world would rise,
Should take the papers and advertise,"

and right well obey the injunction it enjoins. In the management of telegraph companies there appears much of the "penny wise and pound foolish" system. A deep-rooted antipathy, arising from ignorance, exists towards the electric telegraph; the uninformed invariably associate it with thunder and lightning, and conceive the offices to be as dangerous of approach as gunpowder magazines. Familiarity may breed contempt, but unfamiliarity engenders fear; hence measures should be

adopted to assure people that the mysterious-looking cases which they sometimes see at railway-stations, and which have been described as combinations of the beer-engine and the eight-day clock, are but simple pieces of mechanism, and that no danger need be apprehended from their employment. A little treatise on the telegraph in the form of a handbook would do much towards setting doubts and fears at rest, and prove an effective medium for advertising tariffs or other information concerning the business of a company, and its claims to public support. A step in this direction was taken by the London District Telegraph Company in the beginning of the present year. Thousands of copies of a pocket calendar were circulated, and if it is not a consequence of this course, it is certainly a fact that the balance-sheet of this company for the half-year ending the 30th of June last, compared with the accounts for the corresponding period of 1863, shows a marked improvement in the receipts arising from general business. These efforts should be multiplied, and the public, from the Land's End to John o' Groat's, should be made as familiar with the telegraph as they are of cheap excursions to the sea-side.

THE AWARD OF FIFTY THOUSAND FRANCS TO M. RUHMKORFF.

It has been previously announced in these columns that M. Ruhmkorff had gained the prize of 50,000 francs, offered by the Emperor of the French for the best application of electricity. The prize was originally offered in 1852, and its award entrusted to a commission composed of the following gentlemen:—M. Dumas, senator, President; MM. Pelouze, Regnault, Rayer, Serres, Becquerel; Baron C. Dupin, Baron Ségnier, General Morin, General Piobert, and H. Sainte-Claire Deville, all members of the Institute; M. Reynaud, inspector-general of roads and bridges, and chief of the lighthouse service, and M. Jamin, Professor of Physics of the Faculty of Sciences in Paris. The report of this commission has been published in the *Journal de l'Industrie du Commerce*, and contains some very interesting information.

In 1858 the commission proceeded to the award, and came to the decision that there was no application of sufficient importance to warrant the disposal of such a prize, but petitioned the Emperor to allow the offer to stand good for the next period of five years. The present report announces a notable improvement in the application of electrical power, and awards the grand prize to M. Ruhmkorff. M. Froment has been raised to the grade of officer of the Legion of Honour, at the suggestion of the commission.

In the third place the commission recommend the repetition of the offer of the prize of 50,000 francs, and this recommendation has been acceded to by the Emperor. The report of the commission is from the pen of its President, M. Dumas.

M. Ruhmkorff, it appears, was formerly a workman in the employ of some of the best instrument-makers in France, became afterwards a manufacturer on his own account, and finally head of one of the first establishments in Europe. He is essentially a self-educated and self-made man, and, in the words of the report, "worthy to serve as a model to the many intelligent workmen engaged in the manufacture of instruments of precision."

After referring to the discoveries of Ampère, Œrstedt, and Faraday, the report goes on to say:—Every time that the electricity of the pile comes into contact with a conducting-wire and produces a current therein, every time that the communication and the current are interrupted, the phenomena which are produced are not confined to such transmission or interruption of the current. The bodies in the neighbourhood of the conductor are influenced. If the wire which receives the current is wound round a bobbin, and this in its turn is enveloped in another bobbin of uncharged wire, each time that a direct current is created or interrupted in the former, a current is produced in the latter in the contrary direction. In multiplying these interruptions or in rendering them more frequent, the inductive coil becomes an electrical apparatus of a special and novel kind, and presents phenomena which resemble those of the plate machine. From the year 1851 M. Ruhmkorff has devoted himself to the construction and perfecting of such apparatus; and he has succeeded in giving his name to it, in raising it to importance in a scientific point of view, and in endowing it with an amount of energy which fits it for the basis of serious applications. The apparatus of Ruhmkorff, then, combines the two forms of electricity which were separated by a long interval, that of the frictional machine and of the pile. The effects of the Ruhmkorff apparatus are well-known; it can be charged almost instantaneously, its spark inflames combustible substances, melts metals and the most refractory minerals, and reproduces all the effects of lightning, and pierces without difficulty masses of glass four inches in thickness.

Electricity can now be employed to illuminate glass tubes in such a manner as to be highly useful in mines, or other places where there is danger of explosion; under water, for divers; and in surgery, for throwing light into the mouth or other parts, without producing any sensation of heat. The Ruhmkorff apparatus has been found particularly useful for marking the instant of the departure of projectiles and that of their striking any object, and thereby measuring their velocities. Five hundred have been constructed expressly to inflame the gas used in the Lenoir gas engines, and it is in everyday use in quarries, tunnels, and other situations for the firing of trains of powder, for which its regularity of action, its great power, and the distance through which it operates, render it peculiarly adapted. The few elements which it requires, stated at three in lieu of a hundred, and its capacity for firing eight or ten trains or mines at the same instant, are also great additional advantages. In 1858 it was employed with great success by Lieut. Trève, of the French navy, in the removal of the bars formed in the lagunes of Venice; and in 1860 it was with it that the principal fort of the Peïho, in China, was blown up by the firing of eight mines simultaneously, and that the strong iron stockades were cleared from the bed of the river.

The report dwells at considerable length on the application of electricity in the mechanical arts, for purposes of illumination in electro-metallurgy and in surgery.

With respect to the first of these divisions, the report says, that notwithstanding the great improvements that have been made, the "electric-horse" costs, at present, twenty or thirty times more than the "steam-horse," and that, "as a motor for works requiring power, electricity is therefore yet far from supplying a substitute for steam." But there are many cases in which it is serviceable, such, for instance, as in the Lenoir machine, in which the sudden ignition of gas causes an instantaneous elevation of temperature, first on one side of a piston in a cylinder and then on the other, and thus creating a motor; or for producing, at a given moment, and at a distance, the movement of light mechanical appliances which direct the action of other parts moved by powerful mechanical means, acting in this latter case after the manner of the nervous system in animals, which transmits the orders, and leave to the muscles the task of carrying them into effect. In this way it has been used to throw into action the brakes of railway carriages, causing the impetus of the wheels themselves to retard their own progress; and, acting on the same principle, experiments have been made with the view of making steam boilers feed themselves spontaneously.

Reference is made also to the engraving of rollers by means of a design drawn with non-conducting ink on metallic paper; to the copying of a design from one roller on another, as in the machine of M. Gaiffe; and to the pantographic apparatus of M. Cazelli, which is described as capable of transmitting from one end of France to the other despatches in any language whatever, tracing drawings, or whatever is delineated on a sheet of metallic paper prepared for the purpose, and reproduced on another paper rendered chemically impressionable to the electric current; to the weaving machinery of M. Bonelli, which, although not found to succeed in complicated work, will, it is expected, be eventually applied usefully in other cases.

"But," says the report, "it is in those cases in which the mechanician desires to transmit a feeble force to a great distance, as it were, with intelligence and exactitude, that electricity stands at present without a rival," and it is thus that it is so eminently adapted to telegraphic purposes. M. Dumas dwells very emphatically on the system of Professor Hughes, which is explained at length; and, looking at the inconceivable rapidity of transmission which is obtained by it, the learned reporter believes that if to the combinations of Professor Hughes were added the celerity of finger of a pianoforte player, there seems no reason why a reporter should not be able to transmit a speech to Strasbourg, Marseilles, and Bordeaux, while it is being spoken in Paris.

The commission, however, properly points out that the practical application of the wonderful powers of electricity depend greatly

on mechanical exactitude, and says that the combinations of MM. Bonelli, Cazelli, and Professor Hughes remained in the condition of mere experiments until M. Froment, a manufacturer of instruments of precision in Paris, undertook their construction.

As regards illumination by electricity, the report commences with a reference to the extraordinary combinations and experiments of Sir Humphrey Davy (after whom it may be mentioned, *en passant*, a street has just been named in Paris), with a pile of 2,000 elements, having a superficial area of more than a hundred square yards, and which M. Dumas himself repeated thirty years since in his public lectures, and then refers to the Bunsen pile, which contained but thirty elements, and to the many unsuccessful experiments made to light towns by electricity, an attempt designated as a mistake, on account of the fact that the value of electric illumination is in great single lights, which are unsuitable to purposes where dissemination is required. Reference is made to the application of the hard residue of the gas retort in place of charcoal; to the production, by M. Jaquelin, of the Paris School of Mines, of an artificial substance purer and cheaper than the former; to the arrangement of M. Léon Foucault, by means of which the light itself regulates its conductors; to Mr. Staite's invention for the same purpose; to M. Serrin's self-lighting regulator; and lastly to the new apparatus invented by M. Foucault, which M. Dumas considers the best yet produced.

The report then arrives at the application of dynamic electricity to the same purpose, and details the results that have been arrived at by means of the scientific apparatus of Pixü, as applied, in Belgium, by Nollet to practical purposes. A Parisian company, the "Alliance," has applied a modification of this apparatus with perfect success in the slate quarries of Angiers, in the workshops of the railway of the north of Spain, and many other places. The most important application, however, of the kind has been made at Havre, an electric light having been placed on Cape La Hève, near a light-house of the old kind of the first order. A comparison of the two gives the following results:—The light of the latter is equal to 600, and that of the former to 3,000 carcel lamps, the cost of the oil-light being equal to seven centimes for each unit, while that of the electric light is rather less than two centimes, the expenses of the light-house and the interest on the capital engaged all included.

The report gives special praise to M. Oudry for his galvanoplastic work on cast and wrought iron, and the Emperor has rewarded M. Oudry with the Cross of the Legion of Honour.

With respect to medical electricity, the report alludes to the success which Dr. Duchenne, of Boulogne, has met with in the treatment of chronic affections of the nerves and muscles, and to one hundred and forty cases, reported by M. Middeldorf and other surgeons, of the successful treatment of polypi and tumours, by by means of platinum wires heated by electricity.

In the conclusion to the report, M. Dumas says, as the chemist declares that there is neither creation nor loss of matter, so the philosopher maintains that there is neither creation nor loss of power; heat, light, magnetism, and electricity are but manifestations of various conditions of an ether in movement, and are transformed one into the other with the utmost facility. Of these forces, electricity has been the most recently studied, and its properties are still the most mysterious, notwithstanding the grand discoveries which have been made. It may be said, in fact, from the observations made since the commencement of the century, that of all the manifestations of the movements of the ether, those which give rise to electrical phenomena are at once the most delicate and the most fruitful.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XII.

A.D. 1810, July 18.—No. 3363.—Stebbing, George.—"Certain improvements on the action and other parts of sea and land compasses," consisting of:—1st. For "the metal or steel" "center or point" that supports the card is substituted "a ruby, jewell, precious or any other hard stone or composition" set in metal, and long enough to bring the card near the centre of gravity. 2nd. For the "tap" or "bottom of the cap," "hard metal" or stone is substituted for agate. "In the center thereof is sunk the section of a small circle or sphere, well polished, to receive the head of the ruby" that supports the card, "instead of the socket in the agate, as before used." 3rd. The ends of the magnetic needle are made square, "by reducing the width of the needle to its thickness." 4th. "In time of action or very bad weather," the card and needle are suspended by a silk thread, "about one quarter of an inch off the center, hung from the glass by means of a swivel or hook" "to the top of the cap, or from a piece of metal put across the kettle or bowl;" "and at the bottom of the cap, under the card," "a piece of tube about an inch long, in a conical shape," is placed, so that the card will neither touch the side of the kettle nor be thrown off the centre. Or the compass may be suspended "with elastic springs."

A.D. 1810, August 14.—No. 3371.—Whitmore, William.—"The magnet toy, to facilitate the teaching of children to spell, read, and cypher in any tongue, with ease to the teacher, pleasure to the learner, and proportionate expedition." This toy consists of a box (containing mechanism) having depicted on its upper surface "either the letters of the alphabet, numerals, types, symbols, or musical notes, according to the views of the teacher," arranged in a simi-circular form, somewhat like the plate of a dial; an "index," revolving about the centre of the dial, carries a horse, "or other captivating, whimsical, or attractive device;" at the pleasure of the teacher the horse is made to take up any loose duplicate letter or sign laying on "another concentric, &c., exterior, semi-circular, inclined rim," opposite to those on the dial, and to deposit it on a flat simi-circular rim, which occupies the remaining half-circle to that from which the duplicates are taken; the horse also nods, shakes his head sideways, and has other motions at the will of the operator. The horse's head is balanced by a weight concealed within the body, and acted on by a string from the front of the box, passing through the hollow index centre and the leg, so that on its being pulled the horse's head is depressed, and a magnet placed in his mouth is brought into contact with a piece of iron on the duplicate; on releasing the string, the concealed balance weight raises the horse's head; another string, having its two ends projecting from the front of the box, passes round a pulley on the index axis and turns the horse round; the head is then depressed, the duplicate strikes against an upright ridge, and is deposited on the rim. Another method of moving the horse is described and shown, in which a handle connected with a shaft and pinion moves a crown wheel on the index axis; levers, rods, and tubes give motion to the horse's head.

A.D. 1812, January 23.—No. 3525.—Rowland, Richard.—"Certain improvements in ship's steering wheels, compasses, and binnacles, and in the mode of lighting the same." A binnacle is described and shown having three compartments in the upper part. A compass card is in each of the end compartments, respectively "suspended" on metal centres fixed to the bottom of the compartment. Each compartment has a door and "wings" on hinges, so as to protect the vertical glass over the compass; also a skylight, over one of which a rule and "a pair of lights" [sights?] is fixed to ascertain the "bearings of any object seen." The centre compartment contains the light, which can be drawn up close to the compasses, and is minutely described. Rollers and curtains exclude the light when necessary, and a "time-glass" is fixed "on a center" at each end of the binnacle. "When the glass comes to an upright position the compass card is about one foot in diameter." The cap of the storm compass "is fixed under the card, so that the center of suspension is in the plane of the upper surface of the card." "The lubber's line is on a swinging pendulum" whose fulcrum is "in the plane of the center of suspension of the card." The lower part of the binnacle has three compartments, the two outside ones are cupboards, and the centre one contains a "dripstone" cemented into a pan without a bottom, thus forming a bottom to it. When the steering wheel is mounted fore and aft, instead of athwart ship as heretofore, a square binnacle is used with a "lighthouse" at one corner. The cards are viewed in a similar manner to that of the former binnacle; they are, however, transparent, and placed one underneath the other. The light is lowered and raised by a cord, and lights the cabin as well, the bottom of the binnacle being glazed. Various compasses are described with centres fixed in the bottom of the box, with or without "gimbols." The box is filled with spirits of wine. A method of preserving candles is also described, by dipping the wicks into melted tallow, and packing them in a vessel of water, oil, or spirits, or in a water-tight case in a vessel of water.

A.D. 1813, January 30.—No. 3644.—Crow, Francis.—"Certain improvements in the mariner's compass or boat compass." This compass has a "card or index that floats in alcohol contained in a metallic bowl, suspended by gimbals." "The card or index of this compass is constructed of two concave metallic plates, which

are hermetically sealed or soldered together, forming a lens, within which is contained and firmly fixed a magnetic needle." A glass plate confines the liquid in the bowl, and permits the card to be seen; in the centre of the inside of the glass plate a metallic point is cemented, which projects downwards into "an inverted hollow cone" fixed on to the centre of the upper part of the card; to the centre of the under part of the card a weight is attached, keeping it in an horizontal position and "adjusting its pressure on the point of action." To stop the vibratory motion of the bowl, a "rod" is attached to the centre of its external surface, having "a tender spring, which is received by a concave metallic dish attached to the compass box underneath the said bowl, on the surface of which dish the said spring freely acts." Another method of stopping the vibration of the bowl is described and shown:—"A segment of a sphere (the radius of which arises from the line of suspention) is attached to the inferior side of the said bowl, acting against the extremity of a tender spring arising from the side or other part of the compass box." A "spring valve" admits the escape of expanded air in a hot climate. The alcohol is replenished by means of a chamber round the upper part of the bowl.

A.D. 1813, February 4.—No. 3646.—Alexander, George.—"An improved mode of suspending the card of the mariner's compass." The agate cup, receiving the steel point on which the needle is free to move horizontally, is suspended by gimbals; also the point on which the needle moves is suspended by gimbals. This is accomplished by having a "fork" with "two prongs" stand up "perpendicularly" from "the bottom of the brass (or other suitable metallic) box;" "a gimble ring" is suspended by screws between the prongs, within which ring the agate cup is similarly suspended. "In the centre of the magnetic bar, on which the card is placed, there is a large circular opening to admit through the fork, at the north and south sides of which are fixed two small upright pieces of brass (or other suitable metal), holding between them by a screw from each a large gimble ring, on which gimble ring is erected at the east and west sides a gallows or arch of brass (or other suitable metal), in the centre of which, directed downwards, is the point which rests in the agate (or other substance) cup below. On the top of the gallows or arch there is placed a thin piece of concave brass (or other suitable metal) about one inch diameter, and in the centre of the glass, immediately above, is fixed a prong pointing downwards, which acts within the cavity of the brass (or other suitable metal) below."

A.D. 1813, November 25.—No. 3760.—Duncombe, John.—The title of this invention refers to all the improvements set forth in the specification, and is as follows:—"My invention and improvement, as hereafter described and applied to mathematical and astronomical instruments, in order to render them more portable, accurate, easy, expeditious, and certain in their application to topographical and nautical surveying, and the mensuration of celestial angles on land or sea, and for ascertaining the direct distances of inaccessible objects within a limited extent at one station only, without the usual or any other calculation. These inventions and improvements consist in a new index, which ascertains the measured quantity of an angle to any proposed rational degree of precision, by rendering the divisions of those minute parts hitherto imperceptable to the sences truly conspicuous and distinctly legible by the common naked eye; and an attached new parallel movement, by which the natural sine and cosine of such angle are at the same time precisely obtained to any eligible radius, without tabular or other reference; and also a detached new parallel movement, furnished with telescopic or other sights, by which the direct distances of inaccessible objects within a limited extent are accurately measured at one station without trigonometrical or other calculation; and a new improved compass, whose index points due north and south, and which is capable of adjustment according to the known or observed variation of the magnetic needle." The "improved compass" has "a brass or other non-magnetic index fitted to the cap of the magnetic needle, and which is capable of being always adjusted thereto, according to its known or observed variation from the meridian, and thereby caused constantly to point due north and south. This improvement is general to the compass of every description."

A.D. 1818, May 7.—No. 4259.—Jennings, Henry Constantine.—"An improvement in the mariner's compass, being a means of guarding or protecting the magnetic needle of it from all action arising from iron in its neighbourhood." The compass is "mounted and fitted up in the usual manner with gimbals, glass cover, wooden case, &c.;" but the needle card carries "four pieces of iron softened by annealing," two being "screwed to the card at each end of the needle," these "are intended to act as guards against the passage of the magnetic fluid, by absorbing the first quantity of it." Iron filings, carefully annealed, are made to surround the needle by being enclosed "between the sides and bottoms of the brass or copper boxes which enclose the needle and card;" the sides and bottoms of the boxes are kept exactly the same distance apart, truly circular, and flat; and "the needle card, &c.," is "suspended on a point accurately in the centre of the box." The "guards at the ends of the needle" are of thin sheet iron, bent so as to be concentric with the card centre when they are fixed, thus forming segments of a circle. The iron for the "guards," as well as the iron filings, are annealed "by being enclosed in a soft plate iron box, and intimately mixed either with alumine clay, in fine powder," or "an argillaceous iron ore;" the box is then "well covered with a soft plate iron lid," "exposed to a strong red heat," and let "remain in the oven or furnace until it is become cold," the powder is then separated from it. The kind of needle "used by the late Dr. Gowen" [Gowan?] "Knight" is preferred.

A.D. 1819, May 18.—No. 4374.—Atkins, George.—"An instrument for ascertaining the variation of the compass." This invention consists of:—1st. "Certain improvements in magnetic needles." Two steel wires or arms, having north polarity at their free ends, are affixed "to the south half of the needle, forming equidistant angles of about sixty degrees with the north end of the needle." Owing to the magnetic force to which the needle is subject being greatest when the needle is 90° from the meridian, it is believed that this needle will have greater magnetic force and steadiness than a needle of the usual construction. Another improvement in magnetic needles consists in making the needle, in vertical section, of the form of a "segment of a circle, or of an elipse, or of a polygonal figure, having a ring or aperture at bottom to admit the central point, and two horizontal ears at the ends, to which the card is attached." In this needle the magnetic fluid is in a vertical line near the extremities. 2nd. A collar (suspended at its centre on a pillar by gimbals) carries a dial, engraved as a compass card, and able to be set to any required point, either by a compass mounted on the cap of the collar, by the binnacle compass, or by one in another compartment of the same box. The collar has a limb, with a long and short sight moveable on it and on the dial, and a weighted hollow cone to balance the instrument. In another construction, the collar is balanced on a pivot, and carries an arm with "a vertical crotch," "having a slit or notch which slides freely (but without any shake) on a steel fixed to the side of the box." In a third arrangement, the central collar is suspended by external gimbals affixed to the box. A balance weight is attached. Also a cheaper form is described, in which a wooden dial plate is suspended to the box by gimbals, and one removeable sight is used.

A.D. 1824, August 5.—No. 4996.—Graydon, George.—The title of this invention is:—"A new compass for navigation, and other purpurposes;" but it relates to a "celestial compass," which is "adapted to obtain data for determining the latitude or longitude at sea by means of the heavenly bodies, and at a time when the horizon is obscured, and also of finding the azimuth of the sun or a star at any time when these objects are visible." This compass may also be used "in place of the ordinary magnetic compass," and for "ascertaining the variation of the magnetic needle." No magnetic needle is used in this compass; in obtaining "the moon's meridian, distance, and declination, as data for determining the latitude or longitude," however, it is directed to turn the instrument round upon a vertical axis until certain horizontal axes, and consequently a certain line, "is found, by the aid of the common magnetic needle, or any other convenient manner, to be somewhere near the plane of the meridian." Modifications of this instrument, and methods of adjusting it for use "by day when the sun is visible," "for steering a ship by means of the motions of the heavenly bodies, instead of steering by the magnetic needle," and for "taking bearings on land, or for laying down angles in surveying by means of the heavenly bodies, without using a magnetic needle," are described at length.

Advances by Directors for Necessaries.—If a company has incurred a debt for necessaries supplied to it, then, whatever may be the extent of its borrowing powers, any director or shareholder is justified in paying off that debt; and if he does so, he has, in equity, a claim to contribution from the other shareholders. This equity is, however, postponed to the claims of regular creditors of the company. This is the decision of Vice-Chancellor Wood, in the case of Lowndes *v.* the Garnett and Moseley Gold Mining Company of America (Limited).

THE EXTERNAL PROTECTION OF DEEP-SEA CABLES.

WE quote the following statement from the report of the late Submarine Telegraph Committee, as it will enable our readers to judge for themselves as to how far the Committee of the Board of Trade, and that of the Atlantic Telegraph Company, coincide in their views as to the best form of cable for deep-sea purposes:—We have ourselves made experiments upon several forms of cable specially devised by various persons for deep-sea lines. The following table gives a general view of the results. As one of the main objects to be attained is a minimum of extension with a maximum of breaking weight during the process of laying, we have compared the results by showing for each cable the equivalent length in water due to a definite elongation and to the breaking weight:—

NAME.	General Description of Arrangements for Strength and Protection.	Specific Gravity.	Length of Cable in Water in Fathoms equivalent to		
			0·5 per cent. of Elongation.	1 per cent. of Elongation.	Breaking Strain.
CABLES IN WHICH THE STRENGTH IS PLACED IN THE OUTER COVERING BY MEANS OF HEMP OR WIRES LAID ON SPIRALLY.					
			Fathoms.	Fathoms.	Fathoms.
Clark, L.	Steel wire, with a slight spiral, covered with tape, shellac, and marine glue	1·92	1,610 1,119	Not reached. Not reached.	Not broken. 3,376
Gisborne & Forde (Gibraltar deep sea)	Steel wires, coated with hemp, laid spirally	1·9	1,176 2,440	1,947 3,924	Not broken. Not broken with a weight =5,683 fathoms in water.
Siemens	Strands of hemp, laid spirally, protected by thin copper sheathing	1·5	1,842 2,046 1,694	2,552 3,672 3,284	Not broken. Ditto. Ditto.
CABLES IN WHICH THE STRENGTH IS PLACED IN THE OUTER COVERING BY MEANS OF HEMP OR WIRE LAID ON LONGITUDINALLY.					
De Bergue	Tarred hemp lines served round with cord of hemp	1·26	5,300 —	8,124 5,908	Not broken. 16,982
Godefroy	Steel wires, coated with india-rubber, and covered with india-rubber canvas	1·9	2,658	Not reached.	3,424
Ditto	Ditto	1·4	2,596 2,596	3,500 Not reached.	Not broken. 3,309
Hall & Wells	Hemp lines kept in place by plaited hemp	1·35	760	1,126	4,420 4 per cent. extension.
Ditto	Steel wire and hemp lines kept in place with plaited hemp	1·6	2,499	Not reached.	2,729
Ditto	Ditto	1·9	2,437	4,525	5,597
Silver	Steel wires covered with plaited hemp	2·8	1,642 1,832	2,260 Not reached.	Not broken. 3,213
Sinnock	Tarred hempen lines, served in a close spiral, with hemp string and iron wire	1·4	622 —	1,088 463	Not broken. 2,855
Ditto	Ditto	1·7	997 —	1,782 636	— 7,132
CABLES IN WHICH THE STRENGTH IN PLACED NEXT THE COPPER CONDUCTOR INSIDE THE INSULATING COVERING.					
Allan	Steel wires laid spirally on copper conductor, outer covering plaited jute, saturated with marine paint.	1·6	1,519 1,283	Not reached. 2,258	Not broken. 2,936
Ditto	Ditto, outer covering india-rubber canvas	1·88	3,405	5,555	7,484
Ditto	Ditto, outer covering Godefroy's compound	1·3	3,835	6,340	6,348

As regards the liability of these cables to kink, we would observe that the Messrs. Gisborne & Forde's (Gibraltar) cable was easy to kink, and was set in kinks by tension. Messrs. Silver's cable was disposed to kink. Messrs. Clark's, De Bergue's, Godefroy's, Hall & Wells', Sinnock's, and Allan's were difficult to kink, and the kinks generally unfolded by tension.

A cable made by Mr. Hooper was submitted after our experiments were concluded, and we had no opportunity of testing it. The strength is given by steel wires laid on in a slight spiral, protected from corrosion by means of vulcanized india-rubber.

The results shown in the above table for Mr. Allan's cables are remarkable. In these cables the strength is given by steel wires laid spirally round the copper conductor, thus using the strength-giving material to form part of the conductor; the area of the conductor is therefore increased, and there is no danger of the conductor knuckling through the gutta-percha from the resiliency of the latter. This addition to the conducting area increases the induction of the cable in the full ratio of the increased area, but it only increases the conducting power of the cable in the proportion which the conductivity of steel bears to that of copper, which is about one-seventh. To obtain the same capacity for the transmission of messages in a cable of this kind as in a cable in which copper forms the sole conductor, the dimensions of the conductor must be increased to give the same ratio of conduction to induction. The insulating material of course requires protection in these as in other cables.

All the cables in the table in which iron is used for strength have been furnished with some protection against corrosion. This is afforded in some cases by hemp; in another case by tape, shellac, and marine glue; in another by india-rubber and india-rubber canvas; in another by a mixture of cocoa-nut and gutta-percha covered by india-rubber canvas.

In the cables in which hemp is used for giving strength, the hempen strands have been protected in one case by a serving of hemp, in another by a combined covering of hemp and iron wire, and in another by a sheathing of copper. The object of employing copper being, that it is not so subject to corrosion in the sea as iron.

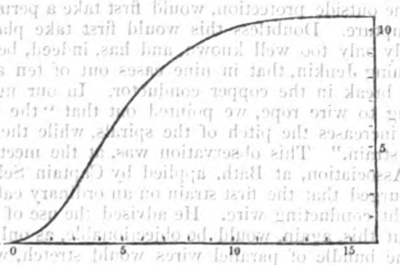
We consider it essential that in iron or steel covered cables the iron or steel should be protected against corrosion, both as a preservative before laying and as a security when laid, to enable them to be raised in case of injury. The protection of the iron or steel covering by hemp alone cannot be durable; nor, indeed, are we satisfied that any of the materials submitted for protecting the iron or steel covering would be durable if exposed to abrasion. It has been suggested that for cables in shallow water, where a solid covering is wanted, the outer covering should be sought in some hard metal not acted on by sea water—probably some alloy. We believe that a coating of tin upon steel or iron wires, with a further protection by means of hemp saturated with tar or some more durable compound, or covered with a cheap form of gutta-percha would be advisable. Cables in which the strength depends on hemp will not be able to be raised for repairs, and unless the hemp is protected will be subject to destruction by marine animals and vegetation, by decay, and by abrasion on hard surfaces. The durability of hemp, however, may be much increased by coating it with some compound of gutta-percha or with marine glue. Whatever, however, be the outer covering, it should prevent any strain being brought on the inner core; the specific gravity should, therefore, be adapted to the depth, and be such as to ensure the cable sinking evenly. We understand that the specific gravity of the Toulon and Algiers cable (1·9), recently submerged in depths of from 1,600 to 2,000 fathoms, has proved satisfactory in practice.

It is also to be observed that the necessity for joints to be made in a cable whilst laying and after it is laid down is sure to occur, and must be provided for. The difficulty of making a joint even in gutta-percha wire has already been alluded to, and whatever be the outer covering, it is evident that it will often be found necessary to make joints in it at sea under circumstances of considerable difficulty. In the ordinary twisted cable a splice can be made almost as secure as the original cable. Longitudinally-covered cables will necessarily present greater difficulties, and the fact that joints will have to be made must be borne in mind in the selection of the outer covering of a cable. When three or four wires are included in the same covering, a defect in any one of the wires renders it necessary to cut the entire cable, and this difficulty is no doubt an objection to this kind of cable.

MEETING OF THE BRITISH ASSOCIATION AT BATH.

We publish brief abstracts of two papers read at the Bath meeting of the British Association, which will be perused with interest by all persons engaged in telegraphic pursuits:—

"On the Retardation of Electrical Signals on Land-lines," by Mr. Fleeming Jenkin.—The retardation of electrical signals through submarine cables has been studied closely for some years; but on land-lines, owing to the difficulty of the experiment, and small influence of the retardation on the signals usually employed, little attention has been paid to the phenomenon. The invention of automatic instruments, such as Professor Wheatstone's transmitting signals, which succeed one another with great rapidity, now renders the retardation an important element of calculation, even on the common aërial lines. The electric current is never received at a distant station at the very instant of its transmission; it arrives gradually, as represented in the annexed curve, in which the horizontal ordinates represent the times



after the circuit has been completed in terms of a quantity a; while the vertical ordinates represent the relative strengths of the current at each moment: thus, on any circuit the received current will have reached about 65 per cent. of its whole strength after a period of $6a$. The quantity a varies with the circumstances of each case, and is equal to $\frac{kcl^2}{\pi^2}\log_e\left(\frac{4}{3}\right)$, where k = the resistance of the conducting wire per unit of length, in electrostatic absolute measure; c the capacity per unit of length in the same measure; and l the total length of the wire; k is known for all the ordinary metals, but c has hitherto been undetermined; and the object of the paper was to deduce the value of c from some experiments made by M. Guillemin, and fully detailed in the "Annales de Physique et de Chimie" for 1860. These experiments gave with considerable accuracy the form of the curve for various lengths; but the experimenter had not applied his results so as to give the constants required for the mathematical theory. After describing the method employed by M. Guillemin with high commendation, Mr. Jenkin gave the results of his calculations. The electro-statical capacity per foot of the common No. 8 wire in the lines used by M. Guillemin must have been from 0·15 to 0·22 in British absolute electro-static measure (feet, grains, seconds). This number is nearly three times that given by pure theory for a wire stretched horizontally, without supports, at a uniform height of ten feet from the ground, a discrepancy probably to be accounted for by the induction occurring at each post. The form of the curve was also modified by imperfect insulation. The retardation due to this statical charge—the capacity for which is thus determined—not only delays the signals, but causes confusion and utter illegibility if they succeed each other too rapidly. A limit is thus put to the performance of signalling instruments; and calculations made with the above value of c show that we must not expect to transmit by the common Morse instrument more than about twenty words per minute between stations 1,300 miles apart; that the performance of Professor Wheatstone's beautiful automatic transmitter may be limited to speeds below 120 words per minute when 530 miles are exceeded; and that the Chevalier Bonelli would have to diminish his speed of 400 wo ds per minute (with five wires), even on considerably shorter circuits. It must be remembered that larger wires, fewer posts, and a better form of insulator may considerably extend these limits.

"On Balata and other Gums regarded as a Substitute for Gutta-percha," by Dr. R. Riddell.—The paper spoke of the gum as a very excellent substitute for, and quite equal to, the adulterated or reboiled gutta-percha from Singapore. They were indebted to Dr. Van Holst, of Amsterdam, Berbice, for bringing this gum first into notice in 1860. It abounded in the forests of British Guiana, and was especially prolific at the time of the full moon. On the day of the full moon the yield of gum was from six to ten times greater than at other times. After the tree had been tapped it could be tapped again every two months. The wood was used for building purposes and for furniture, and he was informed the tree was not injured by being tapped. A tree yielding a gum similar in every respect was discovered to exist by General Cullen and Colonel Cotton in 1853 growing along the whole line of the Western Ghauts on the Malabar coast, Southern India, from lat. 8° 30′ to lat. 10° 30′, at an elevation of from 2,500 to 3,000 feet above the sea. The climate of the country where the bullet-tree is found in Berbice is unhealthy; but however that may be, probably some of the free slaves of America might be induced to settle there and become traders. The Rev. A. M. Norman, alluding to the fact mentioned by Dr. Riddell of the sap flowing more freely at the time of the full moon, said some people were inclined to laugh at such statements, but there could be no doubt that the moon had an important influence on the vegetable world. Dr. Riddell said it was well known to the natives of India that bamboo cut at the full moon was much more subject to the attacks of insects, rotted and decayed sooner than when cut during the dark nights. Specimens of the gum in a liquid state, also in a large block and rolled, were exhibited, appearing freely coloured, but not very agreeable in smell. Other specimens were shown in a manufactured state as vulcanized, hard and soft, and in a state of ebonite. Since the Exhibition a patent has been taken out for working it, particularly for the insulation of electric wires, combined with caoutchouc and various other substances.

THE MECHANICAL PROPERTIES OF THE ATLANTIC TELEGRAPH CABLE.

There may be a trite and even vulgar sound in the popular injunction not to put too many eggs in one basket; but we think that this proverbial expression gives a reason for the success of several noted engineering arrangements, while it, at the same time, no less accounts for the failure of as many others. If a given mechanical apparatus, intended to produce a given effect, be subdivided into a greater or less number of smaller apparatuses, each subdivision being independent in its action from the others—should one of the whole number be injured, the sum total of effects is only fractionally influenced. If one or more of the tubes in a multitubular boiler happen to leak, the boiler, as a whole, is only affected to an amount roughly given by taking the proportion of the number of tubes that leak to the number that remain sound. If the leaking tubes be plugged up, the diminution in the working power of the boiler only extends to a fractional amount of its steam-producing powers. The cellular build of iron ships performs a similar function; one cell filled with water only brings the ship down lower to a determinate amount. A certain very successful valve for large mining pumps, consisting of a large number of smaller valves, cannot, even after working for a long time, give way so suddenly as the ordinary clack. The value of driving workshops with a number of engines and boilers instead of a single cumbrous engine is well-known, and part of the merit is doubtless due to the fact that all the motive power of the works cannot be stopped by the failure of a single apparatus. The same principle may be recognised in the cellular texture of the lungs and of the skin, the organs of respiration—the most indispensable vital function—a cessation of which puts an end to human life in a couple of minutes. Now it is just the fact of being dependent on a single link that makes a chain so insecure. With a chain, all the eggs are in one basket—the failure of a single link brings down the whole number. The efficiency of a chain is, however, only dependent on mechanical conditions. In the case of a submarine telegraph cable its efficiency depends on a number of physical conditions, besides the absolute mechanical condition of there being no mechanical breach of continuity. The conducting power of a submarine telegraphic cable immersed in water would be affected by an opening much less than one-sixteenth wide. In this way we may say that, practically, the Atlantic telegraph cable, 2,200 miles long, is as a chain of that length, with links (say) one-sixteenth long, while the failure of any one of which links would result in the failure of the 2,200 miles long cable. We think that this consideration roughly explains the fact that, out of the 11,000 miles of cable which have been laid since 1840, but a little more than a quarter of this total length is now in working condition.

The counter observations which might be made, "that it is unfair to take the whole number of miles which had been rejected for a few faults," is scarcely logical; or is, at least, only in so far true as it might be applied to a chain cable which, otherwise good, had caused the loss of the ship through a defect in a single link. Calmly considered, and looking at all the difficulties to be encountered in submarine telegraphy, nothing bolder can be thought of than conducting a mysterious fluid through a slender rope thousands of miles long, and laid down in depths never beheld by human eye. Upon the whole, we should say that a good deal of this boldness has been the boldness of want of knowledge and experience. We do not say this because of the many failures that have taken place in submarine telegraphy, but because there is still so much diversity of opinion on many very important points connected with the business, and because so many experi-

ments are still necessary. No doubt the numerous failures may be looked upon as experiments, but these experiments have been rather costly. Perhaps the Atlantic telegraph cable might be considered a very useful experiment, but experiments with the Atlantic for a laboratory must give results somewhat out of proportion in usefulness to expense.

In this engineering case, as in so many others for the last generation, Mr. Fairbairn's invaluable assistance has been secured in making the experiments that will, it is hoped, lead to the next Atlantic cable being itself something better than a gigantic experiment. We should say that if Mr. Fairbairn's assistance had been called upon earlier and to a greater extent before 1858, and if, in fact, an undertaking fraught with such enormous difficulties had been carefully prepared by previous experiment, at least the question whether an Atlantic cable be practicable or not would have been settled by this time. Mr. Fairbairn gave an interesting account of the work he is now conducting for the directors of the Atlantic Cable Company before the British Association at Bath, and he has also contributed a very valuable paper on the subject to our contemporary, the *Quarterly Journal of Science*. He has confined himself more especially to the mechanical properties of the Atlantic cable, and we will strive to briefly follow him in this single direction, one amongst the numerous others from which may be regarded the apparently simple, yet in reality extremely complicated, problem of submarine telegraphy.

Mr. Fairbairn observes that "in deep-sea lines there are three points which require careful consideration, and which appear essential to success, namely, the tensile strength and conducting power of the cable, perfect insulation, and machinery calculated to pass the cable with safety from the ship into the sea." He quotes the table from the commissioners' report, showing the remarkable diminution of the conducting power of copper through being alloyed. For instance, the conducting power of pure copper being taken at 100, that of Spanish Rio Tinto copper is only 14·24. At the time the experiments were made by the commissioners, the remarkable effect of alloying phosphorus to copper—analogous in its effects to carbon on iron—was not generally known. Unfortunately, however, according to Mr. C. W. Siemens, the conducting power of phosphuretted copper is found to be reduced to about one-fifth of what it was before the phosphorus was added. The relative advantages and disadvantages of gutta-percha and caoutchouc, when used for the insulation of submarine telegraph wires, are still a matter of debate amongst telegraphic engineers. Mr. Fairbairn has made a large number of experiments upon the effect of temperature and hydrostatic pressure on both gutta-percha and caoutchouc, and he states that "the general results appear to be that temperature has a very marked effect upon gutta-percha, but that pressure appears to consolidate the material and improve the insulation of both gutta-percha and india-rubber." Few substances are less understood than these extraordinary vegetable gums. Mr. Fairbairn has published, *in extenso*, his experiments intended to determine the value of the different kinds of insulators under severe pressure, and the amount of water they absorbed under hydraulic pressures equivalent to those of the known depths of the Atlantic, and under the combined influence of temperature. He found that the absorption increases "the longer the specimen is retained under water, the greater the pressure to which it is subjected, and the higher the temperature of the water in which it is immersed." The least permeable material was Chatterton's compound, the most was unmasticated bottle india-rubber. The hydraulic pressure was produced in the specimens by immersing them in a steel cylinder containing water, and fitted with a plunger weighted down by a loaded lever. The order of merit in resisting absorption was:—1, vulcanised india-rubber; 2, Chatterton's compound; 3, gutta-percha; 4, masticated india-rubber; 5, Wray's compound; 6, carbonised india-rubber; 7, india-rubber not masticated. The pressure first employed was 5,900 lb. per square inch, but when this pressure was raised to 15,000 lb., Chatterton's compound took the first rank, and gutta-percha the next. In order to test the effect of temperature the steel cylinder was immersed in a water-bath, heated with a gas flame. It was then found that temperature has a very considerable effect on the amount of water absorbed. "Thus gutta-percha, at 45 degrees, absorbed 0·044 grains; at 75 degrees, 0·27 grains, or six times as much. In like manner, india-rubber absorbed 0·177 grains at a lower temperature, and 0·45 at the higher, or two-and-a-half times as much." In order to determine the insulating power of the different cores under pressure, Mr. Fairbairn found it necessary to employ frictional electricity, conducted through a core placed in a steel cylinder, with the ends projecting. At either end of the cylinder were two brass glands, in order to tighten round the core to be tested a vulcanised india-rubber packing. A small cylinder, communicating at right angles with the larger one, was fitted with a solid plunger, to which the pressure on the water was applied by means of a lever. The water, at pressures above 10,000 lbs., appears to have forced its way out; and it is possible that the use of a self-adjusting packing, like that on hydraulic presses, might have prevented this. A summary of results is given, showing approximately the time required in each kind of core for a loss of charge equivalent to a fall of the electrometer needle of 50 degrees. These results are of a very anomalous character. For instance, No. 1, the Gibraltar core, cased by Mackintosh, showed a power of retention of 136 minutes, after an immersion of 282 hours, and under the enormous pressure of 10,000 lbs. per square inch. "At 325 hours' immersion it is reduced to 100 min.; and at 405 hours' it is still further reduced to 32 min., showing that the insulation is very considerably affected when a sufficiently long period of time is allowed for the permeation of the cable." The insulation of No. 6, a core of pure india-rubber, was almost entirely destroyed after an immersion of eighty hours. Mr. Fairbairn says that "the very important question of insulation in deeply-submerged cables is far from having received, as yet, a complete solution. The foregoing experiments are satisfactory, in so far as they show, approximately, the relative porosity of various materials; but they do not point out how we are to obtain an insulator impermeable to water, and at the same time a good non-conductor." Mr. Fairbairn states that a second series of elaborate experiments has been instituted under the direction of a scientific committee. From the drawings and figures given in Mr. Fairbairn's paper, it appears that the Atlantic cable of 1864-5 differs in several important respects from that of 1858. The conductor is a copper strand of seven wires (six laid round one), weighing 300 lb. per nautical mile. These wires are embedded in Chatterton's compound (consisting of gutta-percha and resinous substances). The wires are of the ordinary 18-gauge, and the strand of the No. 10 gauge. The insulation consists of gutta-percha and of Chatterton's compound—four layers of the gutta-percha being laid on alternately with four thin layers of Chatterton's compound. The weight of the entire material forming the insulation is 400 lb. per nautical mile. The diameter of the core is 0·464; its circumference, 1·392. The external protection consists of ten solid No. 13-guage wires, drawn from Webster and Horsfall's homogeneous iron, each wire surrounded separately with five strands of Manilla yarn, "saturated with a preservative compound, and the whole laid spirally round the core," which is itself padded with ordinary hemp, saturated with a preservative mixture. The weight in air is 35 cwt. 3 qrs. per nautical mile. The weight in water is 14 cwt. per nautical mile, or equal to eleven times its weight in water per knot. Its breaking strength is 7 tons 15 cwt., and it will thus bear its own weight in eleven miles depth of water; the contract strain is thus equal to eleven times its own weight per nautical mile in water. The 1864-5 cable is only about 4 cwt. less than double the weight of that of 1858, while its breaking strength is more than double. We should like to know its amount of resilience, or the percentage of elongation it could take without a permanent set. This would give some measure of the amount of injury to which the cable would be liable when paying it out. It would also be interesting to know what portion, whether the core or the outside protection, would first take a permanent set, leading to ultimate rupture. Doubtless this would first take place with the core, and is already only too well known, and has, indeed, been publicly stated by Mr. Fleeming Jenkin, that in nine cases out of ten a failure is accompanied by a break in the copper conductor. In our number for August 26th, referring to wire rope, we pointed out that "the tension on a wire rope merely increases the pitch of the spirals, while the core undergoes a longitudinal strain." This observation was, at the meeting last month of the British Association, at Bath, applied by Captain Selwyn, to telegraph cables. He urged that the first strain on an ordinary cable must be borne by the straight conducting wire. He advised the use of straight wires all through. But this, again, would be objectionable, as only the wires on the outside of the bundle of parallel wires would stretch, when wound on a drum, and it is just these wires that would be stretched in excess of the limit of elasticity. We notice an observation of Mr. Fairbairn, which, coming from such a source, is rather ominously significant. He says, referring to insulators generally, and more especially to the effect of great hydraulic pressure acting through a length of time:—"To solve these questions we require, in my opinion, a long series of carefully-conducted experiments, which would tend to give a reliability to these important undertakings, *which at present they have not attained.*"—*Engineeer.*

THE ANGLO-AUSTRALIAN TELEGRAPH.

Since the date of our last issue the following correspondence has appeared in the columns of the *Times* on the above subject:—

Sir,—Owing to my absence from town, I have only just seen the letter signed "C," in your impression of the 12th instant, in which the writer disputes the practicability of carrying a line of telegraph by way of Singapore to China and Australia, and charges me with an over-developed imagination for venturing to treat of such an enterprise as a work not only possible, but actually to be realized within a short time. Your correspondent commences by asserting that the length of the proposed system between Rangoon and Singapore will be laid for the most part on a coral bottom, while in reality the track laid down for the proposed line passes over regular soundings of sand, shells, and ooze, except near the different landing-places, where the usual massive shore cables will be laid, similar to those successfully used for many years under similar circumstances. Taking the next section, between Singapore and Hong Kong, your correspondent further states that the line must be laid in very considerable depths, while the fact is that the contemplated route by way of Saigon passes over an even and favourable bottom with depths not exceeding fifty fathoms, at which a submarine cable can be repaired without difficulty, or be picked up and laid down again at pleasure. Between Singapore and Batavia the line will be partly submarine, and partly by land through the island of Banca, the former being laid on an even bottom. The water in this section is somewhat shallower than would be selected as a matter of choice, but not more so than is the case with the various cables

crossing the North Sea and English Channel, connecting this country with Denmark, Hanover, Holland, Belgium, and France. It is true that these cables are sometimes injured, but they are speedily restored to working order. From Java your correspondent lays out a route direct from Batavia, being probably unaware that a land line has been in operation for a long time throughout the island. Between Java and Timor soundings have not yet been taken by way of Coupang; but there is no reason to doubt that a suitable route can be laid down. If, however, this should not be accomplished, the cable can be submerged from Madura to Macassar over soundings, and thence to Delli, the Portuguese settlement on the north coast of Timor. Between Timor and the Australian coast the water is shallow, except for about seventy miles south of Timor. On the Australian coast "C" selects Cape York as the landing-place for the cable, and says that a land wire will have to be carried 2,500 miles from that point to Brisbane, Sydney, Melbourne, and Adelaide, to complete the entire undertaking alluded to in my former letter. Even this section is not without its dangers, for his fertile imagination conjures up savages and their squaws to carry off the wire piecemeal. It is fortunate that the greater part of this length is already at work, all the cities enumerated being connected with each other at the present time. The Queensland Legislature have also voted the supplies for erecting the wire from Brisbane to Port Denison, leaving some 500 miles only to complete the communication with the head of the Gulf of Carpentaria (to which point the cable will be extended from Timor with two intermediate stations—one at Port Essington, the other at Wessel Island), and this length the Government of Queensland have undertaken to make when measures are further matured for laying the cable. These few details will show that the idea of telegraphic communication with Australia is not chimerical as your correspondent appears to suppose; and I would venture to remind him that thirteen years since the proposition for connecting England and France by telegraph was equally regarded as a poetic illusion.—I have the honour to be, Sir, your most obedient servant,

1, Victoria-street, Westminster, Oct. 15. CHARLES T. BRIGHT.

Sir,—Sir Charles Bright has made a show of replying to my letter, but he has not answered it. He begins by saying that for the 1,000 miles which lie between Rangoon and Singapore his submarine cable is to lie in soft ooze, except at the landing-places. How can that possibly be, when from the very necessities of the locality it must run through many places for half its course abounding in the coral reefs which are of the nature of these latitudes? The Indian Government had a cable made to connect the two places in question, but, discovering their mistake, abandoned the project. That very cable now connects Malta and Alexandria, and, although lying in soft ooze, has been repeatedly broken. As to the route between Singapore and Hong Kong your correspondent says that the utmost depth of the China Seas is not above fifty fathoms—a depth at which a cable "may be picked up and laid down again at pleasure." What! no difficulty in doing this, when for a great part of the year half a gale of wind blows persistently from one quarter, with the occasional interlude of a typhoon? Sir Charles Bright's cable is, I now find, to have a resting station at Saigon. This will take it full 200 miles out of the straight course, and consequently the total length of this branch will be not 1,500 miles, as I stated, but 1,700. For the first 350 miles it must pass through or along islands with the same coral reefs which so often broke the Dutch cable to the west of the Malay Peninsula. As to the cable between Singapore and Batavia, all that Sir Charles Bright says about it is that it is "to be laid on an even bottom," a quality of bottom which he alone has discovered, but how or where he says not. Sir Charles's submarine cable is, according to his statement, to be reduced by a land wire to pass through Banca. Now, the length of this island is 120 miles, and so the submarine line will be no more than 530 miles. Of the repeated rupture of the Dutch cable, and its ultimate abandonment, the engineer maintains a prudent silence. We come next to the cable to be laid from Batavia, and which, passing through the Straits of Sunda, I made to land at Cape York, the whole distance being about 2,500 miles. From this distance Sir Charles Bright very properly deducts the land wire passing through Java, so that the distance which I gave for a submarine cable in this direction would be reduced to 1,900 miles. Sir Charles, however, seems now to give a preference to a new route, which is to begin with Java or the adjacent island of Madura, and proceed by Macassar, in the island of Celebes, and the Portuguese settlement of Delli, in the island of Timor, and at the head of the Gulf of Carpentaria. The object of this route is to avoid a sea of impracticable depth. From Java or Madura to Macassar the distance is about 600 miles, and from Macassar to Timor it is not less than 780. In the first stage of this route the sea is not shallow enough for an electric cable, but in the last it is sometimes shallow enough; in others, towards Timor, of great depth, and always unequal, with abundance of the coral formation which is inseparable from these latitudes. From Timor to the head of the Gulf of Carpentaria, making Port Essington and Wessel Islands intermediate stations, the distance seems to be about 1,260 miles, making the total submarine cable 2,640 miles, or 140 miles longer than I made it from Batavia to Cape York. It might, indeed, be shortened by a wire across Timor, but this would reduce its length by no more than fifty miles, and the attempt might not be worth making, since most of the country to be passed through is in the possession of wild and mischievous tribes, who owe no allegiance to the Portuguese. Sir Charles Bright tells us that there are but seventy miles of very deep waters, but from whom he has obtained this consolatory information he does not say. The distance from Timor to Port Essington is from 700 to 800 miles, and, I understand, almost every foot of it is water so deep that it has never been fathomed, and which, for what any one knows to the contrary, may be unfathomable. This broad and deep sea, distinguished from the comparatively shallow one to the north of it, forms the line of demarcation which separates two great geographical provinces of the earth's surface from each other, remarkable for the discordance of their vegetable and animal productions, man himself included. Sir Charles Bright says that a telegraphic land communication is already established from Adelaide to Brisbane. By all means, therefore, let them be struck off the work to be done. Still there will remain the land wire from Brisbane to the head of the Gulf of Carpentaria, a distance of not less than 1,000 miles over a desert inhabited by roving savages, with nothing to eat beyond a chance kangaroo. As to the submarine line, the extent of cable which Sir Charles Bright proposes to lay down in three short years' time amounts to 3,878 miles, or but 130 miles short of the breadth of the Atlantic thrice told! Sir Charles Bright reminds me that the scheme for connecting England and France by telegraph was thirteen years ago considered as chimerical as I now consider a connection of the same kind between England and Australia. On my part, I must beg him to consider the difference as to facility of accomplishment of a cable twenty-one miles long, and one which, passing by India, cannot be less than 10,000 long. He admits that the cables which cross the narrow seas of Europe are "sometimes injured, but speedily restored to working order." No doubt they are easily repaired, but only because they are very short; and all the means and appliances, the material, and the skill close at hand. What can there be in common between such a case and an electric wire which extends to the Antipodes, and passes along the shores of barbarians and over wide seas which are seldom visited by the canoe of a savage?

October 17. C.

Sir,—The key to the difference of opinion between your correspondent "C" and myself, as to the feasibility of extending a line of telegraph from India to Australia and China may be found in the following paragraph in his last letter, referring to the depth of water between Timor and Port Essington:—"Sir Charles Bright tells us that there are but 70 miles of very deep waters, but from whom he has obtained this consolatory information he does not say. The distance from Timor to Port Essington is from 700 to 800 miles, and I understand almost every foot of it is water so deep that it has never been fathomed, and which, for what any one knows, may be unfathomable." Upon this foundation a theory is built up that this "broad and deep sea" indicates the point of separation between two great portions of the earth and its inhabitants. Your correspondent will find the information he seeks in the Admiralty chart of the northern portion of Australia and the adjacent islands, published in March, 1862. He will there perceive that the whole of the sea between the Australian coast and Timor, with the exception of a portion varying from 40 to 90 miles from the island, is under 80 fathoms in depth, the greater part varying from 30 to 50 fathoms. The proposed cable between Timor and Port Essington would, as I stated before, be laid in this comparatively shallow depth, with the exception of about 70 miles of its length, as to which we have no information; but there is no reason to anticipate very deep water, nor did I express any such belief. The same chart will acquaint your correspondent that the distance between Port Essington and the furthest point of Timor is 500 miles, the nearest point being 330 miles. It is scarcely fair that "C" should occupy your space and my time in correcting these mistakes when the information can be so readily acquired from the most obvious sources. In his former letter your correspondent asserted that the water between Hong Kong and Singapore was of "very considerable depth." In his letter published to-day he does not dispute the accuracy of my counter-statement, that the depth is not more than 50 fathoms. He states, however, in reference to the section between Madura and Macassar, to which I referred as forming part of an alternative route between Java and Timor, that the depth is not shallow enough for an electric cable, and he gives the distance as 600 miles. I can only refer him to the English and Dutch charts, from which he will see that the depths in this section average 40 fathoms, which I consider a very suitable depth for a cable. The exact distance in a direct line is 330 miles, but this would probably be increased in laying the cable to 360 miles, in order to take the best course. Your correspondent again states that the Rangoon and Singapore line must be partly laid on coral. I repeat that although coral does exist in the sea proposed to be traversed, yet that the cable can be laid altogether clear of it, and that in the actual track laid out the whole of the route is over a favourable bottom. The destination of the present Malta and Alexandria cable was abandoned, not on account of any supposed difficulties between Rangoon and Singapore, but in consequence of one of the cable ships running ashore at Plymouth on her way out to Singapore; this caused the loss of the favourable season for laying, and rendered it necessary to change the destination of the cable, as it was unadvisable to incur the risk and expense of keeping it on board the vessels for another season. Your correspondent refers again to the cable laid by the Dutch Government in 1859 between Singapore and Batavia. This was one of the earliest long submarine lines laid, and was altogether too slight. The outer iron covering was soon destroyed by the chemical action of the salt water, and the naked core was so frequently broken by anchors and currents that it was not worth repairing. It was laid, contrary to the advice of the contractor, between Sumatra and Banco, where the water is very shallow and

where strong currents prevail. The cables which are now proposed to be laid will be very much stronger, and different in many respects from those originally designed for long submarine lines. In reference to the Australian land-line between Brisbane and the head of the Gulf of Carpentaria, which "C" supposes will cross a desert, I may state that the intervening country is now settled to within 100 miles of the head of the Gulf. The Government of Queensland has undertaken to construct this portion of the telegraph, and it may be assumed they have good reason to be satisfied as to its practicability. Your correspondent, referring to the commencement of submarine telegraphy, begs me to consider the difference between laying a short cable in the English Channel and a long one in Eastern seas, and remarks upon the difference between repairing a cable crossing the narrow seas of Europe and the same operation in the parts under discussion. I look upon the connection of England with France by submarine telegraph, considering the state of our knowledge at the time, to have been a more difficult achievement then than the carrying out of the contemplated lines now, and so far as length is concerned the longest proposed section will be shorter than one of the sections of the Malta and Alexandria line, while most of them are not longer than the cable connecting this country with Denmark. With two steamers fitted with the necessary appliances for repairing cables (such as the steamer stationed on the Persian Gulf line), and a store of spare cable at the various stations, there would be no difficulty in maintaining the whole of the proposed lines in efficient and permanent working order.—I have the honour to be, Sir, your most obedient servant,

1, Victoria-street, Westminster, Oct. 18. CHARLES T. BRIGHT.

Sir,—I observe that in "C's" letter, which appears in the *Times* of this morning, he states, with reference to the Rangoon Singapore cable, that the Indian Government had a cable made to "connect the two places in question, but discovering their mistake, abandoned the project. That very cable now connects Malta and Alexandria, and although lying in soft ooze has been repeatedly broken." Now, Sir, as I was engineer to the Government for the cable in question, I am in a position to state that "C" is altogether wrong in the reason he assigns for the change in the destination of the cable. The steamship Victoria sailed for Singapore with a portion of the cable on board in December, 1860, but was met by a violent storm in the Channel, and had to put into Plymouth. This vessel was wrecked in entering the inner harbour. The delay thus occasioned caused the loss of the favourable season for laying a cable between Rangoon and Singapore, and Her Majesty's Government decided to change its destination, and to lay it between Malta and Alexandria rather than incur the expense and the risk of keeping it for several months on board the vessels. The termination of the China war about that time no doubt caused the change in the destination to be less regretted. In my opinion, the depth and nature of the sea bottom between Rangoon and Singapore are more favourable for laying and maintaining a cable than between Malta and Alexandria. It will throw light on the discussion with reference to the India, Australia, and China telegraph if I take this opportunity of shortly stating the results of over three years' experience of the working of the Malta and Alexandria telegraph, which is the first long submarine line which has proved permanently successful. The total length of cable laid between Malta and Alexandria is 1,330 knots, equal to about 1,550 statute miles. This cable was completed on the 23rd of September, 1861, and has, therefore, been submerged more than three years. The first two sections—viz., Malta to Tripoli and Tripoli to Benghazi, a total length of 860 statute miles, which have been laid three years and five months, have never for one moment ceased to work, or given the slightest cause for anxiety, but test at present as well as when first laid. The Malta-Tripoli section has a *maximum*, *minimum*, and mean depth of 420, 50, and 133 fathoms respectively. That of the Tripoli-Benghazi section 150, 25, and 71 fathoms respectively. I regret I cannot speak so favourably of the last section—viz., that from Benghazi to Alexandria, representing a length of cable of 692 statute miles. The sea bottom over this section is much the most unfavourable of the three sections for a submarine cable, having, as the charts will show, a most irregular and uneven bottom, in places very rocky and exposed. At the time this cable was laid it was, moreover, very imperfectly surveyed, although Captain Spratt did his utmost during the short time allowed him to give us proper surveys. As engineer to the Government, I desired to have the cable laid over a uniform bottom of about 50 fathoms, but principally owing to the unavoidable absence of sufficiently detailed soundings this result was not attained on the section between Benghazi and Alexandria. This portion of the cable lies in the following depths—viz., *maximum*, 115 fathoms; *minimum*, 13 fathoms; mean, 47 fathoms. This section has been subjected to three casualties, all occurring in very shallow water, where the cable lies, not as is described by "C" in "soft ooze," but on a hard, rough, and rocky bottom. These casualties occurred as follows:—June 16, 1863, repaired August 10, 1863—55 days out of working order; January 16, 1864, repaired March 19, 1864—62 days out of working order; September 5, 1864, repaired September 26, 1864—20 days out of working order; total, 137 days out of working order in over three years. Had a steamer been at hand ready and available for repairs there is no reason why the total duration of the above interruptions should not have been reduced to about 30 days. In conclusion, I may remark that the Malta and Alexandria cable is much lighter than the cable proposed to be laid in the India and China Seas, and has no external protection to protect the outside wires from corrosion. I leave Sir C. Bright to deal with the other portion of "C's" letters, in which I feel he will have no difficulty, as "C" is evidently writing without having examined the very detailed charts of the seas in question. Apologising for the length of this letter, I remain, your obedient servant,

6, Duke-street, Adelphi, Oct. 18. HENRY C. FORDE.

LAW INTELLIGENCE.

BOVILL *v.* BONELLI'S ELECTRIC TELEGRAPH COMPANY. AGRA AND UNITED SERVICE BANK, GARNISHEES.

On Monday, the 17th instant, in the Lord Mayor's Court, this attachment case was brought before the Recorder and a common jury, in which the plaintiff sought to recover £1,376, moneys in the hands of the garnishees, to the credit of the defendants.

Mr. Mathew, for the plaintiff, said that the defendants were indebted to his client in and above the sum now sought to be recovered. As there was no defence to the present proceedings, the only question for the jury was whether a certain sum of money was in the hands of the garnishees.

Mr. Danby said: I am a clerk in the Agra and United Service Bank. On June 20th Bonelli's Electric Telegraph Company had a deposit account at the bank. The balance on June 30th was £1,376.

As no one appeared for the defendants, his lordship directed the jury to return a verdict for the plaintiff.

Verdict for the plaintiff accordingly.

CORRESPONDENCE.

THE NEW ATLANTIC CABLE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Your correspondent "Progress" has called the attention of your readers to a most important matter relating to the future of deep-sea telegraphy. We all admit the great abilities and experience of Dr. Fairbairn as a civil engineer, but his knowledge of electricity and hempen ropes cannot be very extensive, if we may judge from the paper read before the British Association at Bath, nor, in fact, has Dr. Fairbairn full confidence in the design adopted for the Atlantic cable which he has, nevertheless, recommended after subjecting it to a series of tests at his works at Manchester. It is a great pity that some of those gentlemen who have had practical experience in the manipulation of ropes, and in the submersion of deep-sea cables, were not consulted upon the subject before arriving at a final decision. I believe that the core is constructed upon approved principles, and if successfully submerged will answer the full expectation of its designers. J. MARLOW.

RAILWAY ACCIDENTS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—The importance of the above subject becomes daily more and more urgent, as accident after accident occurs on our lines to the terror of the travelling public. We have had in the space of a few weeks several accidents involving the loss of life and the destruction of property, which it is admitted might have been avoided had an efficient system of signals been in use. I have noticed on several of the lines that the mechanical system of semaphores employed was allowed to remain in a most unsatisfactory condition with respect to the wires conveyed on pullies along the line, the wires in several instances being almost entirely destroyed by rust, or the wheels or pullies allowed to fall down, so as to be of no use in the working of the signals. I believe that on several lines where electric signals are employed too little care is taken to keep the conducting wires in a good state of insulation, which renders the system uncertain in its action, and has been the cause of numerous and serious accidents from time to time. Moreover, it is my opinion that we really do not yet possess an efficient and reliable system of electric signals on any of our lines, and even their diversity is an evil. You have promised a description of Mr. Preece's semaphore system, which, I believe, has been adopted on some of our principal lines; but as I have not read an account of the construction thereof, I am not in a position to pass any opinion as to its merits.—Your obedient servant,

20th October, 1864. A TRAVELLER.

MAGNETIC NEEDLE THREADER.—Magnetism has been applied to a great many useful purposes, with more or less success. The most recent invention in which this agent has been applied is a needle threader, patented in America June 14, 1864, by Oliver Cox, of Washington, and since assigned to Munson, Cox & Lemon, of that city. This threader consists of a small piece of steel, having a straight groove on one side for the reception of the needle, and a taper hole opposite to where the eye of the needle comes, to to conduct the thread into the eye. The steel is magnetized, so that the needle to be threaded is held in the groove by its attraction, without the aid of a spring. By this means the threader is made very simple, and affords much greater facility for threading a needle than the threaders with springs. It can be used for needles of various sizes, and does not get out of order.

TELEGRAPHIC NEWS.

The Telegraph in New South Wales.—A comparative statement of the revenue of this colony, during the quarters ending 30th June, 1863, and 30th June, 1864, shows that the receipts from the electric telegraph have increased £15.

South Australian Telegraphs.—The sum of £3,000 has been voted for telegraphic extension to Blanche Town, on the Murray. The New South Wales Government are about to construct an independent line of telegraph between Sydney and this colony.

Telegraphy in India.—The faulty part of the telegraph cable on the Mussendom to Gwadur section has been discovered buried in earth. The defective part has been cut away, and will be replaced by new cable, when the line will again be opened for traffic.

Atlantic Telegraph Company.—On the 20th instant a call of £1 5s. per share was made by the directors of the Atlantic Telegraph Company upon the £5 (8 per cent. preferential) shares, making £8 15s. per share paid up. A further and final call upon the preferential capital is expected in January next.

Telegraphic Communication between Malta and Alexandria.—We are glad to learn that telegraphic communication, after an interruption of about twenty days, is now re-established to Alexandria, and that the Malta and Alexandria line is again open to the public. This speedy restoration of the electric telegraph reflects great credit on the expedition.

The Russian American Telegraph Line.—The first working party connected with Capt. Bulkley's great expedition for the construction of the Russian and American telegraph line, left New York on the 24th ult., in the steamer Golden Rule, for San Francisco, via Nicaragua. The party consists of Mr. Conway, telegraph engineers, and a number of assistants, who, under the directions of Capt. Bulkley, will proceed to various points in British Columbia, to make the necessary surveys preparatory to more active operations next spring.—*The Telegrapher.*

Telegraphs in Europe.—A comparative estimate, just published, shows that the telegraphic lines in France comprise 98,446 kilometres (each five-eighths of a mile) of wire, and 1,301 offices, which transmit about a million and a-half private despatches a year, and nearly half as many official ones. Russia has 48,884 kilometres of wire; Austria, 29,640; Italy, 25,561; Prussia, 32,273; Spain, 23,665; Belgium, 6,238; Switzerland, 4,960. In Spain and France the telegraphs are under the control of the Minister of the Interior. In Russia, Prussia and Italy they belong to the Ministry of Public Works.

Private Telegraphy.—A line of telegraph has just been completed by Mr. Bartholomew, for Messrs. Hawthorn, between their engine works in Leith and Granton. Several important improvements in insulation have been introduced. The instruments differ widely in their construction from those which have hitherto been adopted in several parts of the country. The instruments generally adopted require the use of both hands, or of the feet and hand for the purpose of generating electricity and sending the message. Bartholomew's instruments, however, require the use of only one hand. Hitherto one of the chief objections to private telegraphy has been the extremely complex nature of the mechanism, which, coupled with the great number of springs, has proved a fruitful source of annoyance from the frequency of their failure. The instruments at Messrs. Hawthorn's, however, are said to be marked by an almost total absence of springs, and have even proved to be less liable to derangement than any other kind.—*Building News.*

Telegraphy in America.—On the 26th ultimo was published in New York, under the auspices of the National Telegraph Union, the first number of a new monthly, yclept *The Telegrapher.* A copy is to hand, from which we learn that it is intended to contain from time to time, "besides a review of the origin, progress, and aims of the Union, and the proceedings of each and every monthly meeting of each and every district, the orders, instructions, recommendations, and calls of the President, the quarterly reports of the Treasurer, and his detailed annual report, the proceedings (except such as are necessary to be kept secret) of each and every meeting of the Convention of delegates, the orders, bills, resolutions, and enactments in full of the Conventions, editorial matter, original articles on telegraphy, telegraphic history and progress, extracts from telegraphic works, improvements in the art, promotions, changes, and removals of telegraphers, and, in fact, to contain everything honourable and truthful pertaining to the union of telegraphy." *The Telegrapher* is edited by Mr. L. H. Smith, who appears to have spared no pains in rendering the journal worthy the art it represents. We greet our trans-Atlantic contemporary with a hearty welcome, and wish it every success.

Electric Telegraph in Queensland.—The establishment of telegraphic communication between Brisbane and Moreton Bay has been most successfully accomplished. The work was commenced on the 28th of June. The most favourable place for starting the connection between Stradbroke and Moreton Island having been decided upon, it was found that, in order to avoid the flats and sand-banks, about 1,800 yards more cable would be required here than was expected; and altogether about four miles of cable were yet to be laid. It is not intended to use any portion of the cable which remains after laying the necessary quantity between Cleveland and Dunwich, as it is not thought desirable that any splicing of the cable should take place. The landing of the necessary apparatus was found very difficult and laborious, owing to the nature of the wide beach that extends from Dunwich into the sea. It was, however, successfully accomplished. The land line from Lytton to Cleveland, and from the north to the south side of Stradbroke Island, is being rapidly completed, and it is expected that, simultaneously with the arrival and laying of the remaining portion of the cable, it will be ready for the transmission of messages. The receipts of the telegraph for the quarter ending June 30th, 1864, were £1,368 11*s.* 5*d.*; for the quarter ending 30th June, 1863, £1,151 9*s.*, showing an increase in the telegraph revenue of 1864, of £217 2*s.* 5*d.*

Communication with the Cape.—An important maritime enterprise was commenced on the 14th instant, when the Union Company's Royal Mail steamer, Athens, sailed from Plymouth for the Cape of Good Hope. It is not intended that this boat shall return in the usual course, but she will henceforth ply between the Cape and the Island of Mauritius. This inaugurates a new line, which is subsidized by the British Government. Mauritius, as is well-known, is an island in the Indian ocean, 600 miles to the east of Madagascar, at which the Australian steamers stay to coal before coming on to the Red Sea and Suez. These steamers run monthly, and by the fortnightly communication now established between Mauritius and the Cape, a new route to and from the latter is established overland through France viâ Marseilles, the Red Sea, Suez to Mauritius, thence westward by the steamer Athens, now put on, to Port Natal and Cape Town. To Natal this will be the shortest, although not the least expensive route. It is as allowing of speedy communication with our important colonial possessions at the Cape by electric telegraph, however, that this new line will be of most value. At present no news thence can reach us under thirty days, or thereabouts. Henceforth that time will be lessened by nearly one-half. An electric telegraph exists between Cape Town and Natal. From Natal to Mauritius may be estimated at a five days' voyage, and from Mauritius by the Australian mail steamer to Suez at eight or nine days. From Suez there is a telegraph direct to London, and therefore, for purposes of news, the British possessions at the Cape may be reckoned as a fortnight distance from England, instead of a month as hitherto. When the Red sea telegraph is open to Aden, which it will be very shortly, this time will be further lessened by two days. The girdle round the earth is being drawn tighter. —*Western Morning News.*

Suicide of the Manager of the West-Ham Gutta-Percha Company.—On Saturday morning, the 15th instant, Mr. Charles de Ridout, a French gentlemen, the manager of the West-Ham Gutta-Percha Company, committed suicide, under circumstances showing singular deliberation. The deceased gentlemen, aged 65, resided at Norfolk-terrace, Westbourne-grove, Notting-hill. He was married, and had two or three children. Latterly he became, it is said, involved in heavy pecuniary difficulties through some loss which he experienced, and he was at times afflicted with great depression. No apprehensions were entertained by his friends that he was about to commit suicide; but at the hour of twelve o'clock on Saturday, the report of a pistol-shot was heard proceeding from the stables at the back of the West-Ham Company's Works. The attention of a police-constable was called to the fact, and an entry was effected into the stables. The unfortunate deceased was found lying on the flooring covered with blood, which issued from a wound in the head. By his side was a pocket-pistol, which had just been discharged, and it was evident that the deceased had placed the muzzle to his head, just behind the right ear, and sent the bullet into his brain. He nevertheless did not breathe his last until half-past two o'clock. He left two letters, one addressed to the coroner, referring chiefly to his pecuniary troubles, the other to his wife, to whom he wrote in the most affectionate terms. The deceased was well-known among a large circle of business men, by whom he was highly respected. An inquest was held on the 17th instant, by Mr. Payne, coroner, at St. Bartholomew's Hospital, on the body of the unfortunate gentleman. The evidence taken was confirmatory of the facts as to the pistol-shot being heard in the stable, and the finding of the body of deceased afterwards. Mr. Edward Broughton, clerk of the Gutta-Percha Works, said he knew the deceased for three years. Witness never observed that his mind was disturbed in any way. The letters produced were in deceased's handwriting. Witness knew that he was involved in pecuniary difficulties. The accounts of the deceased with the company were perfectly correct; but it appeared that he was about to be discharged, his services not being required, as the West-Ham Gutta-Percha Company had transferred its business to the India-Rubber, Gutta-Percha, and Telegraph Works Company, and he was apparently desponding on that account. A letter addressed by the deceased to the coroner and jury was likewise read. After stating his pecuniary difficulties, he writes: "I die, believing nothing but hoping all things. I write all this, because there is always so much said about death being a rash act, a rushing into the presence of one's Maker without God's permission. I feel but an instrument in God's hand for my own just punishment. I placed all my happiness in a home to which I had no right, for I had not the means necessary to keep it up. What tricks and subterfuges in order to make this home happy! I am ashamed to make so much fuss about dying, but the thought of them overcomes me. My dying averts ruin from another, who, if I lived, would be ruined." The jury returned a verdict of "Suicide while in a state of unsound mind."

Demolition of the Great Exhibition Building.—On Monday last a number of persons visited the neighbourhood of the Great Exhibition building, it having been announced that it was intended to blow down the two towers that supported the great dome, adjacent to the Horticultural

Gardens, in the Exhibition-road, but the operation was postponed for a day or two, to enable Sir John Burgoyne and other officers of the Royal Engineers, from Chatham, to be present at the operation. The public, however, had the opportunity of witnessing the corps of Sappers and Miners, under Capt. Knocker, at work upon the basement of the towers, where they were engaged during the day in boring at intervals in the brickwork the requisite chambers for the displosion, large orifices being formed for the reception of the explosive charges, some twenty or thirty in number, representing a total undermining powder force of 100 lbs. weight to each tower. These charges are proportioned to the weight and thickness of the walls, and to the distances of the borings apart from one another; and, after the charges are put in, the holes are "tamped," and then fired by electric batteries, at a range of about 200 feet, all the charges and wires being automatically connected one with another. The height of the towers is 70 feet, by 40 feet in circumference, the thickness of the walls being six feet at the base, and an average of upwards of five cubic feet, the total weight of each tower being 15 tons.

INSULATING MATERIALS.—Mr. S. W. Silver, of Cornhill, has forwarded the following interesting communication to the *Times*:—"My dear Mr. Silver,—Intending to send a boat to-morrow to Gaboon, with my letters for the mail, I should be very sorry to miss the opportunity of writing to you, being the last I will have from the coast, for in a few days I start for the interior. Since my arrival here I have sent two cargoes to London, and I am very glad to be through with the trading part. Enclosed you will find a cheque, with many thanks. I have succeeded in collecting about 13 tons of rubber, which I sent in the Renshaw two days ago. I do not see that there is much difference with the other kind I have seen from the coast. I have sent a batch of gorillas to the British Museum, and I have also shipped a live one, which I sincerely hope will reach London safely. I had three of them alive a few days before the vessel sailed. Now I am going to work in earnest, and I can assure you that I will find but very little time to feel lonely, for it would not do for a man who has no one to converse with to have nothing to occupy his mind in a country like this; the only danger is to fall ill, for one always feels dull afterwards. Thanks to a kind Providence, I have enjoyed very good health, though I have taken a good deal of quinine since my arrival on the coast, but generally as a preventative. I hope to go a long way into the interior. The bed you had made for me is a capital thing, and I will think of you often at the end of a day's work, when I shall rest comfortably on it. Post-office arrangements are not very good here, so do not give me up as a dead man if you are a year or two without hearing from me. I can only assure you that I will often think of you, and of the many pleasant hours we have spent together. Please remember me kindly to ——, and with my best wishes, believe me, yours very sincerely, P. B. DU CHAILLU.—Fernand-vaz River, August 20, 1864."

MISCELLANEA.

ELECTRIC LIGHT.—At Lorient, during some experiments with the electric light, a signal mast was fixed at 700 yards and at 500 yards from two ships, when the signals given by flags from the summit of the mast were rendered perfectly visible on board by means of the electric light. A third experiment caused great surprise and admiration. A diver descended twenty feet under water, and by means of the light was enabled to distinguish the decimal divisions on a scale which was sent down to him, and to give proofs of it. This experiment was deemed conclusive. It is now established that an electro-magnetic machine may be permanently fixed to light large workshops, submarine works, and narrow passages into harbours. It was further observed that when the lime-light was brought to bear on the water shoals of fish were attracted to the surface by the unusual appearance, and continued to swim round the part lighted. Eels, and other fish which were at the bottom of the sea, came up to the surface.

PULFORD'S MAGNETIC PAINTS.—We were at a loss to understand the meaning of the above until, upon making enquiries, we found that the body of the paint, being iron, when dry, *i.e.*, not ground in oil, will adhere to the magnet—hence the name. At first we were under the impression that these paints were the same as the metallic oxide; but we have ascertained that the common metallic oxide has no magnetic properties, but is merely the coloured earth obtained near the iron mines, which, undergoing certain processes, is then ground up in oil. From experiments made these paints, we think, are at present unequalled. They have this superiority over the ordinary colours, that they will neither crack nor blister, being affected neither by weather nor climate. They must, therefore, be especially adapted for the tropics. Wherever paint is required we should say that magnetic paints must be decidedly superior to any hitherto used, which must be clear to the most uninitiated, that, from their very nature, give to any surface painted with them a coating of iron, and so preserve it from decay. We have heard from painters who have used them that they have this great advantage, by using this paint even continually, the painters cholic, from which they all more or less suffer, would be prevented. It has been tested upon ships' bottoms, and has been found to preserve the metal sheathing from decay, protecting it from barnacles, weeds, and other submarine matter. We are told that it is used in the French navy, Regent's Zoological, Crystal Palace, and other places of importance.—*The London Commercial Record*.

A TROUBLESOME PERSON IN CHEMISTRY.—A writer in the *North British Review* tells an amusing story, illustrative of the unwillingness to receive new truths which is characteristic of some minds. Long after Sir Humphrey Davy became famous in London circles as the "young chemist" who attracted larger audiences to his lectures at the Royal Institution than perhaps any purely scientific man had ever done before, there was a certain professor of chemistry in the college at Aberdeen who systematically passed over his discoveries. Some bolder spirits among the Doctor's colleagues at length aroused his attention to the subject; and the professor was compelled to take notice at last of Davy's great discovery of potassium. Accordingly at his next lecture he began by saying: "Gentleman—Both potash and soda are now said to be metallic oxides—the oxides, in fact, of two metals called potassium and sodium, by the discoverer of them—one Davy, in London, a verra troublesome person in chemistry."

A HINT TO EXPERIMENTALISTS.—Early in the month of March in the present year, Mr. F. H. Needham took the preliminary steps to secure a a patent for "electric telegraph cables, or wires, for submarine, subterranean, or over-ground purposes." This invention relates to the insulation of electric telegraph cables or wires without the use of gutta-percha, india-rubber, or such like materials. The patentee proposes to insulate electric telegraph wires by means of *an oxidised surface or coating, which will form a non-conducting covering*. In addition to such oxidated surface he proposes, for submarine wires, to apply thereto a deposit of saline earthy substances, similar to those contained in the sea, such deposit to be formed in combination with the oxidation, or subsequently thereto. The oxidised surface may be caused very readily by means of immersion in diluted acids, such as sulphuric, nitric, or hydro-chloric acid, and by exposure to moist air, or other well-known means; or the oxides of other metals, such as tin, lead, antimony, bismuth, or any of their alloys, may be made to adhere to the surface of the copper conducting wire oxidised or in a bright state. The patent has not been proceeded with.

ELECTRICITY IN WATER.—In a paper addressed to the Academy of Sciences, Dr. Scoutetten endeavours to show that the real activity of mineral waters is owing to their electricity. Imbued with this idea he at first attempted to discover traces of electricity in mineral springs by means of a gold-leaf electroscope, but without success. Continuing his experiments, he found the confirmation of Becquerel's theory, viz., that the earth in contact with a sheet of water manifests electricity; and also that, when the latter is impregnated with air, it takes a quantity of positive electricity, while the earth is negative. The same is the case with sea water, but all mineral springs are negative with regard to the earth. By the aid of Nobili's galvanometer, which is founded on the principle of the deviation of the needle under the influence of a galvanic current, Dr. Scoutetten found that, if a mineral water be brought into imperfect contact with common aerated water by means of a porous diaphragm, and if platinum electrodes be used, a regular pile is formed, and the galvanometer shows the mineral water to be negative, and the common one positive. Extending these experiments to the human body he found that mineral waters determine a current always passing from the water to the patient; they are therefore negative with respect to the latter, and the galvanometer in their case marks 70, 80, and as much as 90 degrees. Hence Dr. Scoutetten explains the efficacy of mineral springs by the three following propositions:—1. That mineral waters all determine phenomena of excitation owing to the electricity they devolve in contact with the human body. 2. That they exercise a therapeutic action, which varies according to the nature of the mineralising elements. 3. That they occasion a topical action which provokes eruptions of the skin.

FISHING BY ELECTRIC LIGHT.—The use of electricity, as a submarine light, is developing rapidly. In a recent number of this journal the application of the light to nautical purposes and in submarine works was referred to; its use in sea fishing is also of interest. It is well known that fish like moths, are attracted by light, and to be fascinated by it. Fishing by torch or other light has been long practised on the French as well as other coasts. The boats carry a skillet at their prow, and a blazing fire is kept by means of fir cones and resinous woods, but this is only one of the many modes in use. In 1857, Mons. J. Atonguia de França-Netto, an engineer of Dunkirk, made experiments in the Gulf of Finland, setting himself the following problem:—To obtain a light that should illuminate the water to the depth of 50 to 200 yards, and which should not be disturbed, like the boat beacons, by the movement of the waves. He made use of a submarine electric light, and in one case four men took a thousand pounds weight of the finest fish in forty minutes, or as much as twenty or thirty would have obtained in the ordinary manner. Having proved that a submarine light affected the fish in the same manner as one above the waves, the next thing was to obtain a lamp that would support the pressure, and the director of the famous glass-works of Baccara has produced for the purpose crystal globes nearly twenty inches in diameter, a centimetre, or two-fifths of an inch, in thickness, and weighing upwards of fifty pounds. Subsequent experiments, some of which were made by order of the French Government, have clearly proved that all kinds of fish are attracted by the light, and that when they have approached within a certain distance they seem powerless to quit the spot, and hover about the spot till captured or driven away. Mons. De França-Netto has invented a new kind of net, or trap, to use with the light, and both have been tried on the coast of England as well as of France. Means are being taken to apply the system on an extensive scale.

The First Printer of Strasbourg.—A correspondent in *Notes and Queries*, signing himself "John Gough Nichols," thus adverts to an attempt to suppress information as to the originator of the typographic art:—The first invention of the Art of Printing is placed in the city of Strasbourg; and until the year 1760 it was attributed to Johann Mentelin of that city, originally a *guldenschrieber*, a writer with or upon gold. Whilst there existed a literary controversy of long duration between the partisans of Strasbourg and Mentz for the local honour of the great invention, Mentelin was always named as the inventor at the former city, whilst at the latter the credit of the invention oscillated between the names of Guttenberg, Faust, and Schœffer. This was the state of the discussion in the year 1760, when Schœpfflin in his *Vindiciæ Typographicæ* appears to have accomplished a triumph rarely gained in such controversies. His arguments effected a sort of compromise satisfactory to the ambition of both cities, by fixing the reputation of Strasbourg as the cradle of typography, but recognising Mentz as the birth place of its inventor. The name of Mentelin was dropped, even by the historians of Alsace itself, by whom it had been commemorated for nearly three centuries; and now a statute of Guttenberg, erected at Strasbourg in a *place* which bears his name, asserts and maintains that he was really the man to whom the world is indebted for this most important art. The name of Mentelin is still on record as that of the first printer at Strasbourg, but with the year 1473 as the earliest date in a title-page or colophon. His advocates [I should mention that my attention has been directed to this subject by a Memoir, entitled, *Quelques Mots sur l'Origine de l'Imprimerie*, ou Résumé des opinions qui en attributent l'Invention à Jean Mentel, natif de Schlestadt; par A. Dorlan, avocat, Bibliothécaire de la ville de Schlestadt: printed at Schlestadt, 8vo, 1840. Whether any reply appeared I have not learned. The author is now deceased.] consider that he had printed for many years before, anonymously. I have not present time or means to discuss the question further: but I have been struck with the sententious and solemn terms of an epitaph said to have formerly existed in the Minster at Strasbourg, and of which I have attempted an English version. It was as follows:—

"I in this grave John Mentelin lie, at length,
I on whom God bestowed such grace and strength,
That from me first, of all men on this earth,
In Strasbourg here, Print-Writing took its birth,—
By types set, used; then moved, and ta'en apart,
And used again, I wrought this beauteous art.
By these *book-sticks* to write in print I taught,
And such fine art thereby so far I brought,
In one day now a man can print outright
All which erstwhile took a whole year to write.
An art so fruitful, as I surely know,
To the worlds end it will increase and grow.
Now't were but due, for all futurity,
To render thanks to God, and eke to me,
As without vanity may well be said;
But, for memorial to be justly paid,
What is enough? where is there means—or room?
Thus God himself provides: that for my tomb—
To prize my Printing in its true degree—
A mausoleum this vast Minster be."

The great question is, Were the assertions of this epitaph true or false? Another, nearly as important, Was it coeval, with Mentelin's death or no? If coeval, there is the greater probability of their being true. In either case, how shall any satisfactory excuse be devised for the conduct of Schœpfflin, to whose library the epitaph is said to have been transferred, and who never restored it to the Minster? (*Notices sur la ville de Strasbourg*, par M. Herrmann, doyen de la faculté de droit, tome ii. p. 413.) By what authority did he not only exalt Guttenberg, but put away the public testimony in favour of Mentelin?

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2533. W. R. Sykes, improvement in apparatus for transmitting positive and negative currents of electricity.
2536. L. J. Crossley, improvements in electric telegraphs.
2558. T. Corbett, improvements in signals or alarums for doors and windows, and for such other uses as the same are or may be applicable to.

NOTICES TO PROCEED.

1442. J. P. Williams and T. Robinson, improvements in annealing wire.
1873. W. Anderson, improved apparatus applicable to the working of moving parts of railway tracks, and of the signals connected therewith, and of other instruments required to be operated in a predetermined order.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good	2/ to 2/3	per lb.
INDIA RUBBER.		
Para, first quality	1/7 to 1/8	„
second „	1/4 to 1/5	„
third Negro-head	1/1 to 1/2	„
Java and Penang	1/2 to 1/4	„

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	104½ to 105	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	⅜ to ⅝	—
5	United Kingdom Telegraph .	3	1 to ½ dis.	—
10	Mediterranean Extension Tel. .	all	3 to 3½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	3⅝ m.	—

TO CORRESPONDENTS.

P. Q.—We believe that most of our telegraph engineers are favourable to the adoption of cables of light specific gravity for deep-sea purposes.

I. Lambert.—Mr. Alexander Bain prepared the solution for the paper used in his electro-chemical receiving instruments by adding nitric acid to a solution of ferrocyanide of potassium until the colour becomes of a dark green, subsequently adding hydrochloric acid until the fluid becomes colourless. The paper immersed in this solution must be used before it becomes quite dry. The following recipe for a solution which answers the same purpose, and also preserves the paper in a moist condition, is given by M. Pouget Maissonneuve:—

Water	100 parts
Nitrate of ammonia in crystals	150 „
Ferrocyanide of potassium	5 „

Amateur.—To test the insulation of your wire connect one terminal of the battery to earth, and the other terminal to line through your galvanometer. The other extremity of the line wire is to be insulated. If any deflection of the galvanometer needle is observed it indicates the amount of leakage.

L. M. R.—The alphabet used for the single-needle instrument corresponds with that employed in working the Morse.

K.—Repeat your first question in a more intelligible form. A *mètre* is 39·37 inches, a *decimetre* 3·9 inches, a *centimètre* and a *millimètre* 0·039 inches.

A Student.—Mr. Highton, in his interesting "History of the Progress of the Electric Telegraph," gives the following accounts of experiments similar to those to which you refer:—"Various experiments have been tried in England, America, and India, with a view to ascertain whether it was possible to send telegraphic communication with naked wires, or even without any wires at all. In England, the author and his brother have tried many experiments on this subject. Naked wires have been sunk in canals for the purpose of ascertaining the mathematical law which governs the loss of power when no insulation was used. Communications were made with ease over a distance of a quarter of a mile. The result, however, of these experiments has been to prove that telegraphic communication could not be sent to any considerable distance without the employment of an insulating medium. In India, Dr. O'Shaughnessy has laid uninsulated wires across a river which is more than a mile broad for the purpose of transmitting telegraphic communications, and he has found it possible to transmit a current along an uninsulated wire of that length, and to obtain at the distant end an action sufficient to work his telegraphic instruments. No less than 250 galvanic cells were required, and even then the signals were scarcely visible. Professor Morse, in America, has tried various experiments in sending currents across rivers without intervening wires. All these experiments have, however, led to no practical result, except that they have proved that, were it necessary to transmit currents of electricity between two stations which are far distant from each other, insulation of a metallic medium is absolutely required. Beyond the proof of this fact, all these costly experiments have proved futile. The experiments themselves have, however, been of the highest value to the science of telegraphing by electricity, and many laws have been deduced therefrom" To the above may be added the experiments of Sir W. Watson, 1747, and Dr. B. Franklin at a later period. Mr. Alexander Bain conducted a series of experiments in Hyde-park in 1841-2, and Messrs. Beardmore, Piggott, Lindsay, and others, at subsequent dates.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

Quarterly, 4*s*. 4*d*. | Half-yearly, 8*s*. 8*d*. | Yearly, 17*s*. 4*d*.

TO ADVERTISERS.

THE TELEGRAPHIC JOURNAL.

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STATISTICS OF THE TELEGRAPH.

It occasionally happens that an inventor lives to see the offspring of his genius adopted by his countrymen, and employed to the advantage of mankind. Mr. W. F. Cooke is fortunate to be able to enjoy these privileges. Less than thirty years ago the electric telegraph was looked upon as a philosophic toy—ingenious certainly, but inapplicable to useful purposes. The representations of its inventor as to its capabilities were favourably entertained by a few enlightened men, while others readily denounced them as the productions of a disordered imagination. We have now become familiar with the telegraph; it is no longer a plaything, but is recognised in every city of importance in the world as a magnificent adaptation of the forces of nature to political, commercial, and social improvement. Annihilating time and space in its operation—facilitating diplomatic arrangements with remote potentates—enabling the merchants of the East to traffic with the traders of the West for their mutual profit—the telegraph has become the universal medium of intercommunication. Gratifying, therefore, must be a contemplation of the progress and continued advancement of so valuable an aid to civilization by the inventor, and others interested in science and art.

The statistics of the telegraph of the United Kingdom (not including private telegraphs, of which there are many in nearly all the large towns of England) are interesting, and show, not only a gradual increase in the number of lines open, but a great improvement in the amount of business transacted. Year by year has the electric cord extended—beneath our pathways, from pole to pole along our highways and railways, across our rivers, above our houses, and from coast to coast on the bed of the ocean itself, bringing into close communion the peoples of the earth, who are separated by distance, but whose interests in the preservation of peace, the extension of commerce, and the advancement of science are kindred to our own. The Government returns of the telegraph for 1863 have been printed, together with a comparative statement of its operations since the year 1861. The marked increase in the number of messages transmitted in 1863 proves at once the capabilities and importance of the telegraph service. In 1861 there were 11,528¾ miles of line open for public traffic; in 1862, 12,711½ miles; and in 1863, 13,892¾ miles, which consisted of 65,012½ miles of wire. Last year the number of stations was augmented in like proportion, and facilities were offered for the transmission of telegrams at no fewer than 1,755 stations, containing 6,196 instruments, through which about 3,400,000 messages were sent. The property and businesses of the several telegraph establishments last year may be thus briefly described:—Electric and International Telegraph Company: 8,230 miles of line, 39,042 miles of wire, and 1,022 stations. The number of messages sent by this company during 1863 has not transpired; but, calculating the proportion of increase from the two years immediately preceding, may be estimated at nearly 2,000,000. The British and Irish Magnetic Telegraph Company: 4,196¾ miles, 17,257½ miles of wire, 464 stations, 827,424 messages. South-Eastern Railway: 316 miles, 2,642½ miles of wire, 94 stations, 62,968 messages. London, Brighton, and South Coast Railway: 212 miles, 541½ miles of wire, 46 stations, 43,208 messages. London District Telegraph Company: 107 miles, 430 miles of wire, 81 stations, 247,606 messages. The United Kingdom Telegraph Company: 831 miles, 5,099 miles of wire, 48 stations, wherefrom 226,729 telegrams were sent.

In addition to the lines actually on British soil, the Submarine Telegraph Company has cables stretching to Calais, Boulogne, Dieppe, Jersey, Ostend, Hanover, and Denmark, with which the other lines are more or less all in connection, covering 887 miles, with 2,683 miles of wire. This company has upwards of 3,000 stations on the continent. The messages sent by it to and from foreign countries were, in 1861, 230,000; in 1862, 310,595; and in 1863, although the mileage was not increased, 345,784. A tabular statement of the telegraph lines in Europe, recently published, shows that France possesses a system comprising 71,034 miles of wire and 1,301 stations, which transmit about 1,500,000 private despatches annually, and nearly 175,000 official ones. Russia has 36,663 miles of wire; Austria, 22,230; Italy, 20,120; Prussia, 24,149; Spain, 17,743; Belgium, 3,773; Switzerland, 3,720. In England the telegraphs belong to joint-stock companies; in France and Spain they are under the control of the Minister of the Interior; in Russia, Prussia, and Italy they belong to the Ministry of Public Works.

The value and importance of the electric telegraph is apparent on consideration of its rapid extension throughout Europe. Next year the foregoing estimate may be supplemented by 12,000 or 16,000 miles of wire. Submarine telegraphy, which has hitherto held a very equivocal position in public estimation, is now on its trial. On the success or failure of the Persian Gulf and Atlantic telegraph cables will depend the confidence of the commercial community, whose aid in the development of the telegraph is necessary to second the skill and experience of our best engineers.

TO DETECT FAULTS IN UNDERGROUND LINES.

Contributed by R. S. Culley, Esq.

In repairing underground wires it is often necessary to find out which is which in places where they are not labelled. To do this it is usual to "put a current on" the wire which may be wanted, and prick or cut through the percha covering of each of the wires in the cable till the current is found.

All these holes must be accurately closed, and as this operation is difficult, and apt to be performed carelessly, several persons have contrived instruments for the purpose of detecting the current without removing the coating, but without practical success.

I beg leave to describe a contrivance of my own, which has been used by my linemen, and which I think any careful person may use with advantage. A light needle, about three inches long, is suspended by a thread in a somewhat heavy brass box, having a glass cover. The box is fixed to a vertical brass rod, which passes through a hole in a short three-legged stand, so as to slide up and down. The stand is placed over the bundle of wires, and the box adjusted, so that each wire can be brought in succession under the needle. To make the needle capable of being moved by a current in a single wire it is, of course, necessary to render it astatic. To effect this I use a bar magnet moveable on the brass suspending rod—a similar arrangement to that used by Professor Thomson in his reflecting galvanometer. As the needle, when nearly astatic, vibrates very slowly, it is not affected by a "working current," and it is delicate enough to pick out a wire having a resistance of thirty Varley's units.

THE CORRESPONDENCE IN THE *TIMES* ON THE ANGLO-AUSTRALIAN TELEGRAPH.

An interesting and important discussion has been lately going on relative to the practicability of establishing telegraphic communication between India, Singapore, China, and Australia by means of submarine cables. A correspondent, who signed himself "C," denied the possibility of laying and maintaining the proposed submarine cables; and the engineers, Sir C. Bright and Mr. Forde, asserted the practicability of doing so. These are the lines concerning which several blue-books have appeared, containing Mr. F. Gisborne's correspondence with the Australian, Dutch, and Her Majesty's Governments, and to carry out which a company was formed last summer. The company, however, has as yet made no public appeal for subscriptions. We (*Observer*) never read a statement of facts which more completely satisfied us that the weight of evidence is in favour of the opinion of the engineers. It is true that "C," as it turned out, had not examined the Admiralty charts, at all, or, at least, not with any sufficient care, and was, therefore, hardly a worthy antagonist to the engineers, who were complete masters of the subject. Still, enough appears to convince us that the feasibility of laying and permanently maintaining these important telegraph lines has been satisfactorily made out.

Without troubling our readers with all the allegations on the one side and on the other, we may state that it appeared in the result that a submarine cable can be laid between India (Rangoon) and Singapore in a depth of 40 fathoms over an even bottom. At the landing-places the water will, of course, be shallower, but there it is intended to lay a much heavier cable. A great point was made of the coral which exists in all the seas in which the proposed cables are to be laid; but the engineers assert that an examination of the Admiralty charts will satisfy any one that the different cables can be laid clear of the coral. It is sufficiently evident that coral can only be dangerous to an iron-covered cable in very shallow water, or where strong currents exist. Under other conditions the cable would lie at rest on the coral, and would not be damaged by it.

The Rangoon and Singapore line will have intermediate stations at King Island and Penang. The engineer to the Malta and Alexandria telegraph states:—"In my opinion the depth and nature of the sea bottom between Rangoon and Singapore are more favourable for laying and maintaining a cable than between Malta and Alexandria." He goes on to state that only one of the sections of the Malta and Alexandria line has ever had anything go wrong with it; and that though the line has been laid over three years, the working of that section has been interrupted in all for only 137 days, which he states would have been reduced to 30 days had a steamer been available for repairs on the spot. We believe that this contrasts favourably with the working of most land-lines. From Singapore it is proposed to lay cables to China in one direction, and to Australia in the other. As regards the line to China, it was admitted that the cable can be laid in a depth of 50 fathoms, and over an even bottom, at which depth Sir C. Bright states that "a submarine cable can be repaired without difficulty, or be picked up and laid down again at pleasure." The line to China, as well as all the lines under discussion, will be divided into sections of 400 to 500 miles, as to which it is stated in one of the letters:—"The longest proposed section will be shorter than one of the sections of the Malta and Alexandria line, while most of them are not longer than the cable connecting this country with Denmark." It is not, however, seriously disputed in the correspondence in question that a cable can be laid and maintained between India and Singapore, and thence to China. The dispute turns mainly on the line between Singapore and Batavia, and from the east end of Java to the head of Gulf Carpentaria in Australia.

As to the line between Singapore and Batavia, it is asserted that the cable will lie in water that is too shallow; and as to the line between Java and Australia, that it will lie in water that is too deep. The allegation as to the small depth of water between Singapore and Batavia is admitted. Sir C. Bright states:—"The water in this section is somewhat shallower than would be selected as a matter of choice, but not more so than is the case with the various cables crossing the North Sea and English Channel, connecting this country with Denmark, Hanover, Holland, Belgium, and France. It is true that these cables are sometimes injured, but they are speedily restored to working order." The depth between Singapore and Batavia is very little over 20 fathoms, and in portions of the sea it does not exceed 10 to 12 fathoms. As regards the line between Java and Australia, it is admitted by the engineers that the sea between Macassar and some 70 miles beyond Timor, being a total distance of nearly 550 miles, has not been sounded; but they state that there is no reason to suppose that this stretch is deep; the sea between Java and Macassar the charts show to be 40 fathoms in depth, and that between Timor and the head of Gulf Carpentaria to be 40 to 80 fathoms in depth.

With the exception, therefore, of some 550 miles, as to which we have no accurate information, the sea bottom between Java and Australia is known to be favourable.

There was some discussion as to the nature of the country between the head of Gulf Carpentaria and Brisbane; but it appears that it is now settled to within 100 miles of the Gulf, and that the Queensland Government has undertaken to carry a land telegraph across that country, the money for the greater portion of the line having been already voted by the Legislature.

As regards the permanence of submarine cables laid at a moderate depth, the only evidence we have is that the Dover and Calais line has lasted thirteen years, and works as well as ever. Deep-sea lines have failed because they could not be repaired. We know that the core of the cable, the copper and gutta-percha, are not destructible by any chemical action of the salt water. They can only be destroyed by mechanical violence. The outer iron covering, however, corrodes; and unless the outer protection with which the recently-manufactured cables have been covered preserves them effectually from contact with the salt water, that will always be a weak point in the complete success of submarine telegraphy. It is, however, a great fact to have determined that we can connect India with Singapore, China, and Australia by a system of cables which may nearly everywhere be laid in a moderate depth. We shall thus, at least, preserve our control over the cables. In a social, political, and commercial sense, as well as a scientific problem, it is right that these great works should proceed, and every one should desire to see them proceed successfully.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XIII.

A.D. 1825, June 18.—No. 5189.—Phillips, Charles.—"A certain improvement or improvements in the construction of a ship's compass." In order to provide against "the firing of cannon or any other circumstances" that "produce violent concussions, such as the sudden jerks produced by the paddles of a steam-boat, &c.," the compass box is mounted on a pivot (the upper end of which is the pivot of the needle), which rests upon a helical spring enclosed in the standard rising from the centre of the bottom of the wooden case. The reacting force of the helical spring is adjustable by means of handles connected with the bearing on which it rests by slits in the tubular standard, the bearing for that purpose resting in suitable notches in the standard. To adjust the centre of gravity of the compass to suit all weathers, a leaden ring is made to move up and down the compass box by palls falling into notched racks fixed vertically on opposite sides of the compass box. "Whenever it blows hard the leaden ring must be raised to such a height as to reduce the motion to that degree which shall be most convenient;" "in fine weather, on the contrary," the leaden ring must be placed "as low as it will allow." The "lubber's point" is placed on the upper arm of a pendulum whose centre of suspension is moveable in vertical guides, so as to enable the lubber's point to be adjusted "even with the upper edge of the compass." The pendulum bob is adjustable so as to make "the motions of the lubber's point correspond with those of the compass."

A.D. 1832, May 30.—No. 6269.—Preston, Grant.—"An improvement or improvements on ships' compasses." This invention "consists of improvements or additions to the common compass to prevent the vibration to which the compass is now subject, and which at present tends to prevent the correct action of the needle." The pin on which the compass card is suspended passes up through a tube or ring attached either to the agate cap or to the card, "and when the card has a tendency to vibrate, in consequence of any motion to the vessel, the lower end of the tube will come in contact with the pin, and stop such vibration. At the same time there will be sufficient play to ensure the action of the needle, and thus will compasses with my improvements applied be more correct in their action." The tube or ring may be either screwed into the agate

cap, or attached to the card by means of arms riveted to the needle. This improvement is applied to the dipping needle by the following means:—The needle, "in place of being affixed to the card," "is suspended on two axes," one on each side of the agate cap, there being an aperture in the centre of the needle to permit the agate cap to pass. The bearings of the needle axes are on the card, which is connected with the agate cap by means of a tube supported by arms from the card, as in the application of the improvements to the ordinary compass. The needle is thus "permitted to swing up and down, as is usual with this description of compass," and any vibration of the card is checked by the lower part of the tube coming in contact with the pin sustaining the card.

A.D. 1834, March 1.—No. 6570.—Pinkus, Henry.—The title of this invention is: "An improved method of or apparatus for communicating and transmitting or extending motive power, by means whereof carriages or waggons may be propelled on railways or common roads, and vessels may be propelled on canals." This invention relates to a pneumatic "railway," in which magnetic attraction may be employed, and which may either form "a complete system of railway in itself," or be applied to common railways or canals. "An extended tunnel, tube, pipe, or conduit," is laid down, which contains a piston. On one side of the piston the air is exhausted from the tube by suitable stationary engines and pumps at suitable distances along the line. To the piston is attached "a vehicle or machine," called "the dynamic traveller," which is in connection with "a car" on the outside of the tube called "the governor," to which the carriages, &c., to be propelled are attached. In the "pneumatic railway" itself, the rails are cast on the sides of the tubes; but in its application to existing railways or canals, the tube is laid down between the rails, or at the margin of the canal. The connection of the "dynamic traveller" with the "governor" is proposed to be made either by means of a longitudinal "pneumatic valve," through which a vertical arm rises, or by magnetic attraction. To apply magnetic attraction effectively, "the dynamic traveller" carries a frame of "horse-shoe magnets" "set transversely," with their poles placed as near to the under surface of the tube as possible. "A similar combination of similar magnets inverted," is attached or suspended "under the body of the governor," and in order to enable the space between the poles of the magnets in the two frames to be as small as possible, the upper part of the tube has a copper plate fitted air-tight into the opening instead of the valve. In the "dynamic traveller" soft iron may be used instead of the magnets. Electro-magnets may be used. Details are set forth of the manner of mounting the "dynamic traveller" and "governor," and respecting the "pneumatic valve," valves interposed at the extremities of a given length of tube called "station valves," and other matters.

A.D. 1834, March 13.—No. 6574.—Hawkins, John Isaac (*a communication from Daniel Harrington*).—"Certain improved instruments for facilitating the cure of disease by administering galvanic influence into the human body." "Various instruments" "compounded of" "any two differently oxidable metals" "by which galvanic influence is excited, the said instruments being respectively so variously constructed as to convey the mild galvanic influence in a convenient manner into or near upon the parts of the body on which it is desirable to operate." "The differently oxidable metals" (silver and zinc are instanced) being placed or pressed in contact with the body and with each other are enabled to generate electric currents by means of the natural fluids of the body. When required, these instruments are made to hold "warm water whereby the parts of the body operated upon may be raised in temperature." The forms of the acting surfaces of the apparatus described in the specification, and shown in the drawings, are suited to the part operated upon, and are smooth or indented according as the part of the body to which they are applied is hard or soft; more than one couple of metals are used in certain cases; and provision is made (when necessary) for the continuity or intermittent character of the electric current, according to the wish of the operator and during the action of walking. The contrivances for "electrizing" the passages of the human body are suited to their sinuosities, and when necessary made flexible. Besides plates, wires of the "differently oxidable metals" are twisted together, made into helices, and woven or platted together, "spangles" "overlapping one another" are sewn on to silk, and a mixture of the filings of zinc and silver (for instance) are cemented upon cloth, &c. The invention also comprises an instrument for puncturing the skin by suddenly letting go a steel spring from its detaining catch, which spring contains the "pointed ends of fine sewing needles, say, from a score to a hundred," and has its action regulated by a perforated plate and adjusting screw, so as to enable the skin to be punctured to the desired depth, and thus render the transmission of the electric current through the cuticle more easy.

A.D. 1837, April 22.—No. 7350.—Ulrich, John Gottlieb.—"Certain improvements in chronometers, consisting of:—1st. "A mode of ensuring a continued action of the balance of a chronometer by means of improved escapements or mechanism, which prevent the liability of the works being brought to rest by any sudden shock or circular motion of the instrument in the plane of the balance." 2nd. "Modes of compensating for the expansion and contraction of the balance spring under variations of temperature," which "allow of the employment of such materials for the balance *as are not subject to magnetic influence* (viz.), platina, palliadium" [palladium?] "glass, &c.;" "and also a mode of adjusting the compensating parts of the pendulum of an astronomical timekeeper." 3rd. "An improved mechanism for stopping the hands of a watch without interrupting the action." 4th. "A new mode of locking and unlocking the striking parts of such chronometers as report the time." 5th. "A mechanism for discharging the striking parts of an alarum or warning watch." 6th. "A mode of preventing the oxidation of the springs of chronometers, by covering them with a thin coat of some metal which is not liable to become oxidated." Coating by immersion.

A.D. 1837, April 29.—No. 7355.—Craufurd, Henry William (*a communication*).—"An improvement in coating or covering iron and copper for the prevention of oxidation." A coating of zinc is employed, which may be covered with a second coating of tin, or of tin alloyed with lead. The zinc coating may either be applied by means of fusion, or "as a paint, which then takes the name of galvanic paint." The metal to be coated is prepared by "scouring;" it is immersed "in water acidulated with sulphuric acid. The acidulated water should be heated in a leaden vessel, or it may be used cold in wooden vessels." The metal is then "thrown into cold water, scoured with sand and a piece of cork," "rubbed with a brush," and "thrown into clean water." Or the pieces of metal may be dipped in a solution of sal ammoniac, or dilute muriatic acid; they should be dried immediately after this last process "and coated with as little delay as possible." To coat iron or copper with zinc by fusion in an earthenware crucible:—"The zinc being melted, it must be skimmed carefully, and its surface covered with sal ammoniac or any flux;" the prepared pieces of metal are then "introduced into the melted metal," moved about, drawn out slowly, and, before the zinc surface "has become set," "thrown into clean water, and rubbed therein with a sponge or brush;" they are then dried rapidly in bran or sawdust; "a grated case with two handles" is employed for plates of the ordinary size; small articles are thrown into the melted zinc and sal ammoniac, taken out slowly with an iron skimmer, "put altogether in a reverberatory furnace, and covered with charcoal," then submitted to a red heat, shaken, and cleaned in a similar manner to the larger articles. Wire may be thus coated by being made to pass through the zinc, and cleaned as above. The "galvanic paint" "is composed of zinc powder well ground and mixed with the substances generally employed for painting;" "the oils distilled from coal tar," or coal tar itself with "spirit of turpentine" are preferred. The second coating with tin, or tin alloyed with lead, is applied to large articles, and to vessels to receive acids or food. The articles are moistened with a solution of sal ammoniac or muriatic acid, dipped rapidly in the fused metal and drawn out slowly, but not so that the zinc quits them: the fused metal is covered with a layer of fat or tallow. [In the "scouring" process, although no mention is made of electrical action in the specification, the immersion of the iron or copper articles in the dilute sulphuric acid, in contact with the leaden vessel, would generate a galvanic current tending to increase the solution of the iron or copper, and to perfect the process. The only way in which the term "galvanic paint" can apply is on the supposition that the iron or copper is partially laid bare, and thus exposed to damp, when the presence of the highly positive metal zinc in contact with the iron or copper would form a galvanic circuit, and prevent the solution or rusting of the iron or copper.] A "Disclaimer and Memorandum of Alteration" was enrolled June 14, 1839, by John James Siordet, John Charles Louis Meyer, and Robert Louis Siordet, to whom the interest in the patent was assigned by Louis Count Jelski, to whom Henry William Craufurd assigned the said interest; in which that portion which relates to "galvanic paint," and the second coating of tin, or tin alloyed with zinc, is disclaimed, and the invention restricted to the mode of "coating copper and

iron for the prevention of oxydation by immersing the same in melted zinc." Also, "the words, 'or any flux,' in the sentence, 'The zinc being melted, it must be skimmed carefully, and its surface covered with sal ammoniac or any flux,'" are proposed to be omitted, they having been "inserted with a view to state that any matter acting in a like manner might be used." A "Disclaimer" was enrolled September 2, 1848, by the same parties, who enrolled the above "Disclaimer and Memorandum of Alteration;" in which the "galvanic paint," the "second coating of tin, or tin alloyed with lead," also the words, "or any flux," are disclaimed; thus restricting the invention to "the mode of coating copper and iron for the prevention of oxydation by immersing them in melted zinc, having its surface covered with sal ammoniac."

A.D. 1837, June 6.—No. 7386.—Berry, Miles (*a communication from Edwin Williams on behalf of Thomas Davenport*).—The title of this invention is, "A certain improvement, or certain improvements, in obtaining motive power for propelling or working machinery." This invention relates to rotary motion obtained either by means of "galvanic" magnets alone, or "galvanic" magnets in combination with "permanent" magnets. This invention consists of a number of electro-magnets fixed radially on a rotating shaft, and segmental permanent magnets ("galvanic magnets" may be used) fixed to the frame supporting the rotating shaft. The motion of the rotating magnets is made to take place, by the approach of their poles to poles of the fixed magnets of opposite names; for this purpose the rotating "galvanic" magnets are made to change their polarity at proper times by the motion of plates (in metallic connection with the conducting wires surrounding the "galvanic" magnets) against fixed segmental plates, corresponding in number and position to the number and position of fixed segmental magnets, which segmental plates are connected in a suitable manner with the poles of a galvanic battery.

A.D. 1837, June 12.—No. 7390.—Cooke, William Fothergill, and Wheatstone, Charles.—"Improvements in giving signals and sounding alarums in distant places by means of electric currents transmitted through metallic circuits;" they are as follows:—A five needle telegraph. The symbols are indicated by the simultaneous deflection of two of the magnetic needles whose coils are included in the circuit, the required letter being found on a dial at the point to which they converge. In this signal apparatus the needles move in vertical planes, they being heavier at the lower ends to enable them to point vertically when not conveying signals; stops limit the angular motion of the needles, and they are astatic, one being within the coil, the other exterior to it on the face of the dial plate. To complete the circuit, a combination of finger keys is used, by which the line circuit is broken at the same time as the voltaic battery and signal apparatus are interposed; and by springs and studs, in connection with the finger keys, the current may be made to circulate in either direction. Five line wires are used in the above telegraph (one to each needle coil), or each needle may be deflected separately by having a sixth line wire for the return current. A four needle telegraph on the same principle, with five line wires, is also described and shown. Methods of insulating and supporting the line wires are described and shown, consisting of placing them in a resinous cement in channels in the rails or post and rail fences; or in various shaped tubes or troughs, the wires being previously covered with cotton, and varnished. A method of deflecting telegraph magnetic needles by electro-magnets. The current is made to magnetise two horse-shoe electro-magnets placed opposite one another, with the needle between their poles; similar poles are opposite, and the deflection takes place according to the polarity (*i.e.* the direction of the electric current). A method of "sounding alarums in distant places." The detent of a clock-work is removed by an electro-magnet, on the completion of the circuit, and is again interposed by a spring on the ceasing of the magnetism; or a hammer is made to strike a bell by similar means. "Sounding alarums in distant places by the aid of an additional voltaic battery." A battery, devoted solely to working the alarum, and not belonging to the line circuit, has its local circuit completed by the electric current from the distant battery. For this purpose the line circuit deflects a needle on whose axis a forked wire is mounted, which completes the local circuit by dipping into mercury cups; or the local circuit may be completed by the evolution of gas (caused by the line circuit), forcing mercury in a U tube into contact with a wire; the tube is closed at one end, and has a bulb containing diluted sulphuric acid, into which the poles of the line wires are inserted. A method of connecting and disconnecting an alarum from the circuit in the needle telegraph, by a bolt connected to the alarum circuit raising a spring in the needle coil circuit, is described and shown. Methods of ascertaining the precise place of injury to the line wires are described and shown; the coils of needles, mounted as in the needle telegraph, are included in the circuit between two of the line wires, one of which is defective, a station battery being connected to them; various points in the circuit are tried until one is found at which the needle is not affected; half the distance between this and the last effective point is then tried until the injury is found. A voltameter may also be used to test the completion of the circuit. To distinguish between the line wires it is proposed to use varnish of various colours.

A.D. 1837, December 4.—No. 7495.—Booker, Thomas William.—"Improvements in preparing iron to be coated with tin and other metals." "A mode of heating the pickling liquor (diluted acid), and in preparing iron plates to be coated with tin and other metals, in such manner that the heat can be more uniformly kept than when heated by the direct action of a fire, by which greater uniformity of production be ensured;" and "a mode of submitting sheets of iron in such manner to the action of the pickling liquor as to ensure their being kept separate, notwithstanding a number of plates are in the pickling trough at one time, the sheets being put into the pickling trough one at a time." Over a fire-place, having a door, ashpit, side flue, and chimney, is placed an exterior vessel containing a smaller vessel of lead, having a space all round it filled with water; the pickle (dilute sulphuric acid) is within the leaden vessel, and is thus subjected to the uniform heat of boiling water. To keep the plates separate they are placed in "grates" of lead or wood, having divisions, two in each division, but not in contact with each other. Every plate is dropped "on its lateral edge singly and separately." After pickling, the sheets are plunged into water, and "remain to be taken as wanted for the further processes of coating with tin or other metals." [Although no mention of electricity is made in the specification, the immersion of the iron plates in the dilute sulphuric acid in contact with the vessel of lead, generates an electric current in which the iron is the positive plate, and which therefore assists in and is favourable to the process above described.]

OCEAN TELEGRAPHS.

The partial success which has attended the attempts to connect England and India by a telegraphic wire seem to have revived the hopes which, after soaring so high five or six years ago, were cruelly disappointed by the failure of the Atlantic line and many subsequent disasters. After all the mishaps that have occurred, it is not surprising that any confident prediction as to future telegraphic achievements should be met with excessive suspicion; and when Sir Charles Bright wrote to the *Times* to say that the Indian telegraph was nearly complete—and that within three years China and Australia may, if we please, be in instant communication with London—it was quite a matter of course that he should be answered by a critic enjoying a preternatural sharpness of vision for the difficulties to which Sir C. Bright was a little blind. Mere spectators, who are neither stimulated by participation in telegraphic speculations nor terrified by the recollection of losses incurred, find it difficult to forego the hope that, sooner or later, all that has been dreamed of universal telegraphic communication will become a working reality. There is a fascination about the very magnitude and audacity of the larger schemes which captivates the fancy, even when it fails to secure actual co-operation. But there is better warrant than any hopes and fancies for believing that the great problems in telegraphy will before long be grappled with, and, it may be hoped, with a better issue than attended some of the earlier premature attempts.

Those who have watched the progress of the practical science of telegraphy, though they see that enterprises of this kind are much too arduous to justify sanguine predictions, know that the time which has elapsed since the most conspicuous failures has not been wasted. With the exception of the Malta and Alexandria cable, and other portions of the line to India, nothing on a very grand scale has been attempted since the breakdown of the Atlantic and Red Sea cables; but not the less, perhaps all the more, on this account science has been making vigorous progress, the causes of past failure have been thoroughly ascertained, and the errors which vitiated the earlier efforts have now been completely exploded. Whether our engineers are yet in a position to promise us a net-

work of telegraphic wires over the whole earth, may be still a moot point; but this great preliminary stride has been taken, that whereas in 1857 almost everything connected with ocean telegraphy rested upon guess, it is now almost true to say that each separate danger has been measured, and the feasibility of almost the most difficult lines reduced mainly to a question of cost. No practical art ever reached this point without ultimately advancing much further, and though it would be rash to conjecture how many more years, and how many more failures, must bridge over the interval before complete success is attained, we believe that there is now less reason than ever to despair of the ultimate triumph of many of the boldest schemes. Out of nearly a hundred submarine cables that have been laid from time to time, it is true that not much more than half are now in working order; and, as a rule, the successful cables have been those of the strongest, the heaviest, and the most costly descriptions. Most of the long cables and deep-sea cables have broken down, but the causes of failure are known. Many of them can be avoided, though not without incurring heavier outlay than was once thought sufficient, and the rest are said to be in a fair way to be surmounted by the improvements in manufacture and the discoveries of science. Whether the projectors of telegraph schemes are not even now too confident of immediate success, nothing but the event can prove; but there are, at any rate, signs to be noted more hopeful than the calculations of sanguine engineers. The project of carrying a cable from Ireland to Newfoundland across nearly 3,000 miles of sea, with soundings occasionally of two and a-half miles, was by far the most audacious that has ever been conceived; yet even for this scheme, after losing a capital of £600,000, the Atlantic Company have succeeded in raising a second fund, and are now busily engaged in manufacturing a cable which is to be payed-out from the Great Eastern in the course of next summer. Every one must wish success to so courageous an experiment, and though it is undeniable that many grave risks still remain, it is equally certain that the principal dangers which caused the destruction of the old cable have been either removed or greatly mitigated. At every stage of its progress a submarine cable is hedged round with danger. There is first the risk of defective manufacture, then the chance of mishap in paying out, and last, but by no means least of all, the certainty of deterioration and ultimate destruction by natural or accidental causes after the cable is submerged. Each of these elements of hazard is undoubtedly much diminished since the abortive attempts of 1857 and 1858. Incredible as it seems, it is a fact that the old Atlantic cable was laid down without any preliminary test of its soundness of the smallest value. A single pin-hole in the coating of 3,000 miles of wire would be enough to ruin the whole enterprise, and until the cable lay at the bottom of the ocean no one could say whether such a defect did or did not exist. Since that time the whole machinery for securing perfect manufacture has been revolutionized. Continuous testing under water detects the slightest flaw at any point, and means have been found for determining with the utmost nicety the precise position of a fault, so that the evil may be remedied at any time until the wire is absolutely out of reach. Practically, there is now no difficulty in ensuring the perfect soundness of a telegraphic cable up to the moment when it it is payed out over the ship's stern.

The second class of risks, those incidental to the laying of the cable, have in great measure been due to neglect of scientific precautions, and are almost entirely obviated now by the use of much stronger cables than were formerly in vogue. The new Atlantic cable, for example, thought very slight in comparison with many others, will be more than twice as strong and nearly twice as heavy as that which was for a time at work, while its weight in water, on which the strain depends, will be scarcely increased at all. But the really formidable risk is that of more or less rapid injury after the submergence. That the wire will be successfully laid, and will remain for a greater or less time in working order, may, in the absence of special ill-luck, be reasonably expected, but very few data exist for forming any opinion how long it will stand. With a mile or two of water above it, it will be safe from the accidents that so often damage more accessible cables; but in this case injury is ruin. Iron will rust, and insects will gnaw, even at the bottom of the Atlantic; and there is, besides, the possibility that the strongest rope of iron and hemp may give way when it lies stretched across the uneven rocks which will probably form some portion of its bed. The great safeguard against dangers such as these is to make the rope very thick and strong; but, in the case of an Atlantic cable, not only the extravagant cost, but the difficulty of stowing on shipboard, and laying 3,000 miles of very heavy cable, rendered it quite impossible to carry this precaution nearly so far as has been done in all the most successful cables. Certainty of wearing out sooner or later; uncertainty how soon the end may come; absolute impossiblity of repairing damages—these are the conditions of the problem. But, after all, the difficulty is reducible to a question of cost, and it must be presumed that those who have ventured once more on the enterprise have done so on the calculation that their cable will be long-lived enough to pay for its construction. Actual experience has shown how very large an income may be realised out of a long cable when in working order, and it is quite possible that a comparatively short term of years would remunerate the Atlantic Company for their spirited outlay.

While experience has thus encouraged the boldest of our telegraph projectors to a renewal of their experiment, under circumstances at any rate much less unfavourable than those of their first essay, it has led other engineers to the conclusion that, for the present at any rate, the safest course is to avoid deep water whenever that can be done. The Malta and Alexandria line was laid on the principle of never exceeding a depth of 100 fathoms for more than a few miles. At the same time, the sheathing was intended to be strong enough to allow of the cable being picked up and repaired at almost any point, as has already been done on more than one occasion. Whether the requisite strength will be retained after a few years of corrosion may be doubtful, but though the limit of danger may have been approached too closely in this particular case, the principle of keeping a cable always accessible for repairs is obviously right, as taking away much of the extreme hazard of such speculations. The controversy in the *Times*, to which we have already referred, raises a very interesting question as to the feasibility of laying telegraphs all over the world without abandoning this useful precaution. If Australia and China can be reached across shallow seas, the Atlantic will be the only deep ocean which it will be necessary to cross. Sir Charles Bright asserts that a route may be selected in comparatively shallow water all the way to China, on the one hand, and to Australia on the other, and that for the most part the inevitable deep seas and coral reefs exist only in the imagination of his critic. The project seems to be to creep in fifty-fathom water from Rangoon, along the coast of the Malay peninsula, to Singapore; and from that point to diverge with one line to the left, by the coast of Cochin China and China Proper, to Hong Kong, and with another, to the right, through Java, and thence by the island of Timor to the Gulf of Carpentaria. According to Sir Charles Bright this last section is the only one where deep water cannot be avoided, and even there he insists that the difficulty would occur only over a distance of seventy miles; so that the cable would be accessible for repair in every other part, and a fault in the worst possible position would not involve any more serious loss than that of seventy miles of wire. It seems to be acknowledged that the soundings are by no means so complete as would be desirable for laying such a cable, but if Sir Charles Bright is right in saying that shallow water is known to exist in all but this short portion of the projected line, there is certainly nothing, in an engineering point of view, to prevent the cable being laid within the three years claimed as sufficient for the work. The occasional or even the frequent occurrence of coral on the route would be rather a financial than an engineering difficulty. It is known that cables can be made strong enough to lie uninjured on a coral bed, and we have no doubt that to lay a cable from India to Australia and China, and to keep it in repair, is a feat quite within the compass of modern science. The completion and maintenance of the Indian line is a matter of much greater doubt. A message sent from Kurrachee on the 27th of September did, it seems, reach Bagdad on the 3rd, Constantinople on the 7th, and London on the 9th of this month; but before the speed upon this line can be materially improved, the Constantinople and Bagdad telegraph must be made secure and effective, and 150 miles of wire must be laid across the Valley of the Tigris, between Bagdad and the head of the Persian Gulf. A more hopeful prospect is afforded by the continuation of the Russian line through Persia to the shores of the Gulf, which is expected to be finished in a few weeks. It is not many years since the notion of receiving our earliest Indian news through a Russian channel would have filled English statesmen with consternation, and, though a telegraph by any route would now be heartily welcomed, it would be more desirable to have a line free from the danger of interruption in the event of a European war. When the Indian telegraph is securely established, by whatever route it may happen to go, the extension to China and Australia would not seem to be attended by any insuperable difficulty; and, if once these lines and the Atlantic

telegraph were laid, nothing but comparatively easy work would remain to complete a network which would leave New Zealand and the Cape almost the only places in the world of any importance excluded from the telegraphic circuit. For the realisation of these, like most other engineering visions, time and money are the only things wanting.

Telegraphy, after all its failures, and mainly through its failures, has passed out of the merely engineering into the commercial phase. Its task now is to prove, not only that this or that cable can be made, but that it can be made to pay. The renewal of the Atlantic enterprise shows that there are capitalists who have faith enough even in that hazardous undertaking to embark in it once more, and, although the Government is not likely to carry its own ventures farther than it has already done in the laying of the Malta and Alexandria cable, private enterprise may be trusted to complete any telegraphic line which promises a reasonable return for the risk incurred. Every year, by supplying fresh experience, reduces the risk of this class of undertakings, and the time must sooner or later come when even the vast scheme of carrying our electric wires as far as China and Australia will be no longer disparaged as the dream of a poetical engineer.—*Saturday Review.*

ON THE INFLUENCE OF TEMPERATURE ON THE ELECTRIC CONDUCTING-POWER OF ALLOYS.

BY AUGUSTUS MATTHIESSEN, F.R.S., LECTURER ON CHEMISTRY IN ST. MARY'S HOSPITAL, AND CARL VOGT, PH.D.

(*Continued from page* 187.)

The value given for the conducting-power of one alloy (lead-silver, containing 30·64 per cent. of lead) in the Philosophical Transactions of 1862 is wrong. We not only used part of the same alloy employed for the former determinations, but also made and analysed a fresh quantity, and found the values for the conducting-power in both cases the same; the present value is therefore the correct one for the conducting-power of the alloy. The error made in the former determinations must have been that a wrong normal wire was noted down as the one with which the resistances of the wires were compared; for according to the data from which the conducting-powers were then deduced, those there given are correct.

In order to show in a clear manner the results obtained, and to explain the law which we have arrived at, we will give in the first place the following tables:—

Alloy.	Volumes per cent.	Conducting-power at 100°.		Percentage decrement.	
		Observed.	Calculated.	Observed.	Calculated.
Sn_6Pb	83·96 of Sn	8·38	8·28	30·18	29·67
Sn_4Cd	83·10 of Sn	10·35	10·10	28·89	30·03
Sn_2Zn	77·71 of Sn	11·70	11·37	30·12	30·16
Pb Sn	53·41 of Pb	7·16	7·21	29·41	29·10
$Zn\,Cd_2$	26·06 of Zn	17·97	17·75	29·86	29·67
$Sn\,Cd_4$	23·50 of Sn	15·36	14·88	29·08	30·25
$Cd\,Pb_6$	10·57 of Cd	6·62	7·03	27·74	27·60

Alloy.	Volumes per cent.	Conducting-power at 100°.		Percentage decrement.	
		Observed.	Calculated.	Observed.	Calculated.
Lead-silver	94·84 of Pb	6·37	9·85	28·24	19·90
Lead-silver	46·90 of Pb	10·63	40·30	16·53	7·78
Lead-silver	30·64 of Pb	18·08	50·83	17·36	10·42
Tin-gold	90·32 of Sn	6·25	13·23	24·20	13·84
Tin-gold	79·54 of Sn	3·70	18·23	22·90	5·95
Tin-copper (hard drawn)	93·57 of Sn	8·58	12·72	28·71	19·76
Tin-copper (hard drawn)	83·60 of Sn	9·39	18·90	26·24	14·57
Tin-copper (hard drawn)	14·91 of Sn	8·37	61·42	5·18	3·99
Tin-copper (hard drawn)	12·35 of Sn	9·60	63·02	5·48	4·46
Tin-copper (hard drawn)	11·61 of Sn	11·30	63·47	6·60	5·22
Tin-copper (hard drawn)	6·02 of Sn	17·89	66·93	9·25	7·83
Tin-copper (hard drawn)	1·41 of Sn	48·89	69·78	21·74	20·53
Tin-silver	96·52 of Sn	8·67	10·90	30·00	23·31
Tin-silver	75·51 of Sn	9·71	23·91	29·18	11·89
Zinc-copper (hard drawn)	42·06 of Zn	19·09	49·57	12·40	11·29
Zinc-copper (hard drawn)	29·45 of Zn	19·21	55·89	11·49	10·08
Zinc-copper (hard drawn)	23·61 of Zn	24·68	58·82	12·79	12·30
Zinc-copper (hard drawn)	10·88 of Zn	38·76	65·20	17·41	17·42
Zinc-copper (hard drawn)	5·03 of Zn	47·93	68·18	20·61	20·62

Alloy.	Volumes per cent.	Conducting-power at 100°.		Percentage decrement.	
		Observed.	Calculated.	Observed.	Calculated.
Gold-copper (hard drawn)	98·63 of Au	43·85	55·33	21·87	22·22
Gold-copper (hard drawn)	81·66 of Au	14·89	57·96	7·41	[illegible]
Gold-silver (hard drawn)	79·86 of Au	19·18	58·25	10·09	[illegible]
Gold-silver (annealed)	79·86 of Au	19·38	*a* 58·25 *b* 60·24	10·21	*a* [illegible] *b* 9·43
Gold-silver (hard drawn)	52·08 of Au	14·05	62·58	6·49	6·58
Gold-silver (annealed)	52·08 of Au	14·07	*a* 62·58 *b* 65·99	6·71	*a* [illegible] [illegible]
Gold-silver (hard drawn)	19·86 of Au	19·88	67·60	8·82	[illegible]
Gold-silver (annealed)	19·86 of Au	19·91	*a* 67·60 *b* 72·68	8·44	*a* 8·63 *b* 8·03
Gold-copper (hard drawn)	19·17 of Au	18·86	67·68	8·07	8·18
Gold-copper (hard drawn)	0·71 of Au	62·25	70·54	25·90	[illegible]
Platinum-silver (hard drawn)	19·65 of Pt	6·49	59·31	3·10	3·21
Platinum-silver (hard drawn)	5·05 of Pt	16·75	67·77	7·08	7·25
Platinum-silver (hard drawn)	2·51 of Pt	28·07	69·24	11·29	[illegible]
Platinum-silver (hard drawn)	23·28 of Pd	8·23	57·27	3·40	4·21
Copper-silver (hard drawn)	98·35 of Cu	65·81	70·66	26·50	27·30
Copper-silver (hard drawn)	95·17 of Cu	61·26	70·66	25·57	25·41
Copper-silver (hard drawn)	77·64 of Cu	52·86	70·66	21·29	[illegible]
Copper-silver (hard drawn)	46·67 of Cu	57·89	70·68	22·75	[illegible]
Copper-silver (hard drawn)	8·25 of Cu	61·69	70·69	23·17	[illegible]
Copper-silver (hard drawn)	1·53 of Cu	71·81	70·69	26·51	[illegible]
Iron-gold (hard drawn)	27·93 of Fe	1·97	42·62	27·92	[illegible]
Iron-gold (hard drawn)	21·18 of Fe	1·64	45·64	17·55	[illegible]
Iron-gold (hard drawn)	10·96 of Fe	2·20	49·68	8·84	[illegible]
Iron-copper (hard drawn)	0·46 of Fe	23·63	70·84	10·94	[illegible]

These tables will require some explanation. Calculated conducting-power means the deduced conducting-power of an alloy, it being assumed that the conducting-power of a wire of any alloy is equal to the sum of the conducting-powers of parallel wires of the metals composing the alloy.

Under the term "calculated percentage decrement between 0° and 100°," we do not mean, as might be supposed, the mean of the percentage decrements which the component metals would suffer in their conducting-powers between 0° and 100°, and which would be, for nearly all the alloys experimented with, 29·307 per cent., inasmuch as it has been shown* that the conducting-power of most of the pure metals decreases between 0° and 100° by 29·307 per cent. (the exceptions to this law being thallium and iron, the conducting-powers of which decrease between 0° and 100°, 31·420 and 38·[illegible] per cent. respectively †). It is therefore clear that the calculated percentage decrement in the conducting-powers between 0° and 100° of most alloys, from the above assumption, must be also 29·307 per cent. It is, however, obvious, on looking at the observed percentage decrements, that the conducting-powers of the alloys, with the exception of those given in the first of these tables, decrease less than 29·307 per cent. between 0° and 100°. In order to avoid repetitions, instead of the above value (29·307), we have inserted under the heading "calculated percentage decrement" that deduced from the following law:—

The observed percentage decrement in the conducting-power of an alloy between 0° and 100° is to that calculated between 0° and 100° (viz., 29·307) as the observed conducting-power at 100° is to that calculated at 100°.

Or writing the above in symbols,

$$Po : Pc :: \lambda_{100^\circ} : \lambda'_{100^\circ}, \qquad (1)$$

where Po and Pc represent the observed and calculated percentage decrements in the conducting-power of the alloy between 0° and 100°, and λ_{100° and λ'_{100° its observed and calculated conducting-power at 100°, Pc is, as just stated, equal to 29·307 in nearly all cases, the exceptions being with the thallium and iron alloys.

If the values so deduced be examined, it will be seen that those given in the first table for the observed and calculated percentage decrement agree very closely with each other, as well as with the mean value found for the percentage decrement in the conducting-power between 0° and 100° of the pure metals—viz., 29·307. This is just what we expected; for these alloys conduct electricity, as will be seen from the table, in the ratio of their relative volumes, and therefore their conducting-powers ought to decrease between 0° and 100° in the same percentage amount as that of the mean of their components.

On looking at the second table, which contains the alloys made of the metals belonging to the two classes, we find that, as long as there is no change in the conducting-power of the metals lead and

* *Loc. cit.* † Philosophical Transactions for 18[illegible].

tin by the addition of another metal, the conducting-power of the alloy decreases between 0° and 100° 29·307 per cent., but the moment the alloys show a greater or smaller conducting-power than that of pure lead or tin, then the percentage decrement is less than 29·307. Again, the alloys of tin or zinc with copper containing small amounts of those metals follow approximatively the above law; and on referring to the curves* which represent the conducting-powers of these alloys, it would appear that, starting with the metal whose conducting-power is greatly altered by a small addition of a foreign metal, the above law, as just stated, is approximatively true for all alloys as far as the turning-point of the curve, and from this point there is no agreement between the observed and calculated values. The difference between these values begins to show itself in some cases much sooner than in others; thus, with tin and copper after the addition of 1 per cent. of the former; with zinc and copper only after more than 10 per cent. of zinc has been added, and from these points it gradually increases with each addition of metal. What the exact law is which these alloys follow with regard to the property under consideration we are unable at present to state, but some of them at least show that the law we have put forth will hold good in their cases. Unfortunately the alloys of this class, containing large percentages of each metal, are exceedingly brittle and unworkable, so that no complete series of determinations with any set of alloys could be made; had we been able to do this with one or two series, we should, in all probability, have found the law which regulates the influence of temperature on the conducting-power of this group of alloys. With regard to those in the third table very little need be said, for the deduced percentage decrements prove that our law holds good for most of the alloys of this group. There are, nevertheless, a few remarks to be made respecting some of the values given in this table—namely, on those of the annealed wires. Elsewhere it has been shown that the conducting-power of hard-drawn wires of some metals is greatly altered by annealing them; with the alloys this does not seem to be the case, for the differences here are very small. On account of their smallness we have not thought it worth while to investigate this matter any further at present; for to arrive at such results as might show the connection between the effect of annealing on the conducting-power of alloys, and on that of the metals composing them, would require a long series of experiments. Although the percentage decrements in the conducting-power of these annealed wires are all somewhat higher than those of the hard-drawn, yet they may be considered the same, as the percentage decrements in the conducting-power of hard-drawn and annealed wires of the pure metals vary also in a small degree, but not always in the same direction. Thus, those found for silver were—

Hard-drawn.	Annealed.
28·67	28·82
28·44	28·67
27·82	28·21

We have calculated, as will be seen in the table, the percentage decrements in two ways—1st (*a*), using for the calculations the conducting-powers of the hard-drawn, and 2ndly (*b*), those of the annealed metals. The values so obtained for the percentage decrement do not differ very much from one another.

In calculating the results for the iron alloys, Pc has not been taken equal to 29·307, but for each alloy Pc has had to be calculated. Thus, for the 1st, iron-gold, which contains 27·93 volumes per cent. iron—

The conducting-power of 1 volume of iron may be said to lose between 0° and 100° 38·260 per cent.; therefore, 0·2793 volume will lose	10·686
That of 1 volume of gold may be said to lose between 0° and 100° 29·307 per cent; therefore, 0·7207 volume will lose	21·122
1 volume of iron-gold alloy, containing 27·93 per cent. iron, will therefore lose	31·808

On comparing the values obtained for the conducting-powers, &c., of the iron-gold alloys, the following facts are worth mentioning—their very low and almost identical conducting-powers, and the high percentage decrements found for the first two and the low one for the third. That there was no error in this value we convinced ourselves by remaking the alloy, which contained, according to analysis, the same percentage amount of iron as that given in the table, and the percentage decrement in its conducting-power was found equal to 4·04. Again, an alloy made by a well-known firm,† which gave on analysis 11·94 volumes per cent. iron, conducted at 0° 2·097, and lost between 0° and 100° 4·30 per cent. of conducting-power. Unfortunately, experiments with alloys richer in iron could not be made, owing to the brittleness of the alloys; the high percentage decrement in the conducting-power of the first two indicating something abnormal, which it would have been interesting to have followed out.

(To be continued.)

* *Loc. cit.*

† We are indebted to Messrs. Johnson, Matthey, & Co., of Hatton-garden, for many of the alloys experimented with. These were the first two, iron-gold, the platinum-silver, palladium-silver, and aluminium-nickel.

ADDRESS OF THE PRESIDENT OF THE NATIONAL TELEGRAPHIC UNION (AMERICA).

We have, on several occasions, adverted to the importance of union, and, in one instance, specially advised the establishment of an institute for telegraphers in England. Nothing has been done, however, towards realising our suggestions; but, perhaps when the advantages which result from such associations are shown, steps will be taken to give effect to our recommendations. Towards the close of last year an institution was founded in America, called the National Telegraphic Union. In the month of September last, a convention of delegates from many of the States was held in Philadelphia, under the auspices of the Union, presided over by Mr. J. G. Smith. The address of the president on this occasion contains some valuable information concerning the operations of the Union; and will afford a few hints to our readers who may be disposed to assist in the establishment of an institute for telegraphers:—

Gentlemen of the Convention,—Ten months ago the first telegraphic convention, elected from among the operators, that ever met in this country, came together in the city of New York.

At the time of the call for that convention a feeling of the necessity of an organisation, similar to that designed, was quite generally felt, but what the groundwork of action could be, what was really the amount of sympathy felt towards a Union, what under our peculiarly embarrassing situation could be done towards uniting ourselves, and what would be the tone and character of the Union, if established, were questions that few could settle to their own satisfaction. Sufficient, however, was ascertained to make it evident that an intelligent and respectable class among operators were anxious and willing to support a creditable Union; and the convention came together representing, through indirect action, a large circle of operators.

The sessions of the convention lasted three days, and it is a great pleasure to be able to say that, in my humble opinion, the first convention was creditable, not alone to the districts to which the members belonged, but to the profession generally; and, considering the newness of the enterprise, the field to be covered by their action, the dangerous questions likely to arise to nullify the preliminary measures necessary to be taken, they brought to the meeting a unity of purpose, an intelligent appreciation of the position and the duties, which would, I think, challenge a favourable comparison with any similar convention among any class of men.

Much of their success was undoubtedly due to the ability with which the presiding officer discharged his duties, and, although I regret that we are not similarly situated in that respect to-day, we still have his example before us, and I trust we may profit by it.

A constitution and code of bye-laws were adopted, which were well suited to the necessities of the occasion, and which were of such a character that any telegrapher could feel gratified at and pleased to support, and the result of which has been that, notwithstanding the difficulties to be overcome, we have, as a body, advanced steadily, although slowly, and have during this short time become a permanent institution.

The constitution was really the starting point—no organisation previous to that having effected that much upon any basis that promised good results—and from the adoption of that instrument we must date the existence of our Union.

We now number, of regular members whose names are enrolled upon the treasurer's books, 250, comprising twelve districts. Many others consider themselves members, and may eventually fulfil the duties required, but at present have not taken all the steps necessary to entitle them to privileges of membership.

Many of the obstacles in the way of rapid and thorough organisation of districts, and the carrying out of all the necessary steps which would leave no question of the existence of full rights and titles, is owing to inattention or lack of interest on the part of the officers of the districts.

The treasurer informs me that he now has in his hands, to the credit of the Union, $393.27. But very few members have received aid on account of sickness or disability, although some individual demands have been large through this source. For details of the financial affairs of the Union, I refer you to the report of the treasurer.

The experience of ten months has shown to us that in many ways we can now improve upon the production of our first essay; and this present convention is met, in accordance with the constitution, to consider what further, or other action, can now consistently be taken for our interest.

To complete and perfect the constitution and bye-laws, and thus establish

a permanent basis upon which our organisation can go forward more rapidly, will, I think, be found sufficient to occupy the attention of the convention at this session.

Our individual duties and our desire to be in no manner a hindrance to the general business of the profession (which we all know to be so conditioned at present that the continued absence of so large a body of practical men from its daily demands and requirements would be injurious), will be sufficient stimulus to prompt us to quick and decided action, so that we may return to our respective stations at the earliest possible moment.

One great impediment in the way of rapid and satisfactory progress has been found in the divided and scattered positions that we occupy. Many places contain but one member, one telegraph operator being sufficient for the locality; and in fact there are but a few places where a sufficient number of members are employed to make, when collected together, a respectable gathering for purposes of interchange of views and ideas. This has necessitated, on the part of the officers and those members who take the greatest interest, a large amount of correspondence and written communications, and, in consequence, a good deal of labour and devotion of all the time allowed from their daily duties, and still much has been left undone.

I would heartily recommend that some means be devised for more frequent, easier and more general communication among members and districts. Those situated in smaller places hear and know, in many instances, scarcely anything of what is going forward, and are very naturally, I think, inclined to believe that nothing is being done, and that no interest is felt in the affairs of the Union.

In this connection I would suggest that the publication at regular periods (say monthly) of a sheet containing from four to eight pages, in my opinion, would be the best means of overcoming these difficulties.

The publication could contain accounts of the proceedings at the regular meetings of the several districts, whereby all could readily see what interest is taken in other districts, and can profit by any valuable ideas or suggestions presented at other points.

Changes will no doubt be made in the constitution and bye-laws, which will render it necessary to issue new copies of them; and, apparently one of the most direct and thorough ways of issuing such documents would be to print them off, together with the proceedings of this convention, in an issue immediately after the close of the session; such issue, perhaps, to be the first of a regular publication. The advantages that such a paper would offer for the exhibition of whatever is progressive and ennobling among operators would accommodate what is, and for a long time has been, almost an absolute need and requirement.

The profession generally, and all those who are interested in the advancement of the science and practical application of telegraphing, could and would contribute to its columns.

Such a publication could be easily supported by the members of this association alone, and could be gradually increased in size with the advancement of the Union and the increase of contributions until, perhaps, we could realise eventually the full idea of a telegraphic review, as comprehensive as that proposed by the vice-president at the first convention.

That a publication of this kind would be of great advantage to us as an association seems almost indisputable. It would advance the standing of the Union; tend greatly toward the removal of the prejudice that now exists between companies and operators; and, properly managed, become a source of revenue.

I look upon it as almost an impossiblity for a telegraphic review to be established and maintained successfully in any other way than through the immediate support and interest of the body of practical telegraphers.

The questions of title, place and manner of publication, the proper person to take charge of its editorial management, price, and other details, can be disposed of without a great deal of discussion or loss of time.

Among the constitutional amendments which seem to me to be necessary will be that regulating the regular dues of members. At present it is fixed at 1 per cent. of the salary of the member. It cannot be legal or right to inquire into the private affairs of members, as this clause of the constitution makes it necessary to do. Our Union, like other institutions, cannot affect to govern the whole interests of the member. We have certain beneficiary provisions and certain regular expenses; these must be met by regular assessments. Moreover, one member has no greater privilege than another, and should not, therefore, be called upon to contribute more than another. Instead of 1 per cent. on the salary, I would recommend that some stated amount per month or annum be assessed.

Neither the constitution nor the bye-laws appear to be explicit and direct enough in their provisions for the organisation and incoming of new districts. Complaints are made that it is necessary to search over both constitution and the bye-laws in order to ascertain how a person or district can attach themselves to the Union, and then nothing absolute is ascertained. Some attention must be given toward remedying this defect, as it is of vital importance that too great obstacles should not be thrown in the way of those desirous of forming part of the association.

A great deal of discussion has ensued among members and districts relative to Article 7th of the constitution, in reference to members who may become incapacitated from their usual duties by sickness or accident. We plainly need some such provision in the constitution, but the amount set down is evidently too large. It is not in proportion to the assessments, and experience has proved that the Union could not afford to retain the provision as it now reads. I recommend that it be modified so as to equalise the advantages derived from the amount paid out by the Union. This could be done by providing for the payment of a nominal sum per week, say five dollars, and placing in the hands of the proper officer the power to limit the length of payments according to the resources of the treasury and the circumstances of the case.

I would suggest that the election of general officers should take place immediately before the adjournment of the convention, instead of upon the first day as provided. A change of the provision will be necessary to do this. It does not appear to me to be the proper time for the election of officers, as many are in doubt as to the ability of those who may be looked upon by a large number as the proper persons for the positions, and too much of the time of the convention is likely to be consumed by discussion and hesitation; whereas, during the recesses of the meetings, members can talk over the requirements of the positions and the character and quality of candidates. Again. As now provided, it looks as though intended that the officers so elected should enter upon their duties at the meeting of the convention, upon the same day. This evidently cannot be the proper interpretation, as the former officers could not make their reports.

At the last session, I am firmly impressed with the belief that a provision was passed authorising the payment of the expenses of delegates from the fund of the Union, but I do not see it in the copy of the constitution. This provision seems to be necessary, and I think a resolution regulating that matter should be passed, and should be allowed to include the expenses of the delegates to this convention.

In order to preserve as much as possible the credit and character of the Union, pains must be taken to investigate the moral qualifications of new members. It is my opinion that no person known to be addicted to drunkenness, even should he be the finest description of an operator (so far as writing and reading is concerned), should be allowed to become a member, unless strong proofs are shown of reformation. Nothing whatever is to be gained by the addition of such men, and nothing is lost by rejecting them. Cases will arise where men known to be good-hearted, intelligent, fine, practical operators, but addicted to this habit, desire to become members, and, although we may not desire to wound their feelings, yet the character of the Union is worth preserving, and when the fact becomes patent that we cannot accept such members they will reform themselves before asking admission, or must expect to be rejected.

Throughout the ten months that have passed since our organisation we have gained in the respect and esteem of the companies that employ us. A telegrapher to-day is not regarded in the same light that he was a year ago. The better class of operators throughout the country are joining our ranks. Our provisions are sufficiently liberal to allow all good men and telegraphers to come into the association, and we institute no unjust or illiberal measures, but only such as are necessary to our progress and the preservation of our standing and character. It will soon be said that those among telegraphers who are not of us must necessarily be defective or unreliable, and we shall find ourselves constantly and steadily gaining in the eyes of those we desire to influence, and progressing in the path that leads to substantial results.

Not being organised upon temporary ground, or for transient and momentary purposes, we need to employ wisdom and prudence in our considerations. Let us not look to present results so much as to the future. Our organisation is yet young, and by the measure of forethought and discretion that we exhibit, shall we be weighed by those who wait to either condemn us or to aid us. While we make no boasts, or threaten any interests, let us prove, by our intelligent action, that we are capable of what we have undertaken, and that the Union and profession are both safe in our hands.

To one occupying the position that I have in the Union, the opportunity has been open to accomplish much by individual exertion and perseverance. But I have been so circumstanced that I have not been able to give to the occasion and the duties the attention they have deserved and needed; and I sincerely hope that you will be able to find, for the ensuing year, some one capable of giving to the duties of the position the attention they require, and that they must have. And I trust that, by the time the convention meets again, we shall find ourselves benefited by our action, and our association growing in favour and in numbers. We must bear in mind that the best results generally come by slow process, but are none the less satisfactory or perfect.

In compliance with the suggestion of the president, a journal in the interest of the Union has been established. *The Telegrapher*, for that is its name, is a monthly, of a decidedly business character, promising to become a thorough representative of telegraphers, and the art with which they are identified. To the columns of this periodical we are indebted for the address of the President of the Union.

The *Louisville Journal* thus refers to the above Union:—"Among the many excellent movements which have been recently made for the intellectual, social, and business improvement of professional persons, the formation of a National Union by the telegraph operators of the country appears to us to be the most important. The phonographer and the magnetic telegrapher have become of commanding importance to the press, and consequently to all classes of society; upon their accuracy and fidelity depends the diffusion of historic truth. As may be presumed, the object of the

telegraph operators in forming their National Union is the advancement of their general interests, and the elevation of the standard of the profession which is productive of so much benefit to the business community. The preliminary organisation was made in New York, last November, by a few of the operators of that city, but since that time it has increased in numbers and strength with great rapidity. Branch districts have been formed in all the States of the Union, from Maine to Salt Lake City, and the number of applicants for admission is greatly increasing. The purposes of the Union are the supporting of its members in sickness and adversity, the elevation of the character and standard of the profession, and the advancement of the general interests of the fraternity in a manner that will produce beneficial results to the employers and employed. A fund for the support of operators in sickness, or while out of employment, is provided by a pro rata assessment on all the members, according to the salary which they receive. All members are pledged to exert themselves to obtain employment for such as are in need of it and deserving. As the peculiar nature of the business calls most of those persons engaged in it from their homes and friends, this provision will be of great benefit to those who, while among strangers, are stricken down with sickness. By the rules of the Union, no person is allowed to receive instruction from members who are not properly qualified and capable of performing correctly and creditably the responsible duties of the art. Of late years many persons claiming to be proficient have obtained employment by such means, and not only brought discredit upon themselves, but upon the whole profession, by their blunders and incapacity. If a proper and judicious course is pursued by the members of the Union, much good must result to themselves, and the interests of the telegraphs of the country will be greatly advanced. What will be to their interests will also be of profit and gain to the public; for, unless correct and reliable operators are to be had, but little service can be gained by the use of the telegraph—now almost indispensable in every-day business life. A branch of the National Union was formed in this city about three months ago. Operators from all parts of the State are included in the district, and some have already reaped the benefit of joining it by being cared for in sickness. The district is in a very flourishing condition, and numbers among its members the best telegraphic talent of this State and of Indiana. All good operators should join the association, and thus not only advance and improve their own interests and standing, but aid in perfecting the general advancement of the useful art of telegraphing."

THE ANGLO-AUSTRALIAN TELEGRAPH.

The discussion on this subject in the columns of the *Times* has been concluded; but since our last publication the following letters have appeared :—

Sir,—I find by your impression of to-day that I have two long-electric cable engineers to deal with—Sir Charles Bright rejoining and Mr. Henry Forde backing up. I have not the least objection to the opposition of any number of these gentlemen. Let us begin by looking to the results of their previous performances before we trust them with our money in laying down cables to China and the Antipodes. The great Atlantic cable was a total failure, accompanied by a heavy loss. No one has succeeded in picking up the two ends, or, as the case may be, its many two ends. It lies at the bottom of the ocean, to be traced by some future geologist in a future revolution of the earth's formation. The Red Sea cable gave one squeak, and for that one squeak the nation is burdened with an annuity at the rate of 4 per cent. for between 40 and 50 years. The cable itself is at the bottom of the Red Sea, along with the bronze of Pharaoh's chariot wheels, to be picked up by a geologist coeval with him who discovers the remains of the Atlantic cable. Next we have the Mediterranean cable, respecting which we have some candid details from its engineer, Mr. Henry Forde. This is not one cable, but virtually three distinct ones. The three sections or cables together give a length of 1,550 miles from Malta to Alexandria. The two first sections amount to 860 miles, giving each an average of 430 miles, and no fracture has taken place in them in the three years since the whole cable was finished. The third and last section, that which runs from Benghazi to Alexandria, 692 miles long, has been broken three times, producing an interruption in the whole line of 137 days, or about one-eighth part of the whole time since its completion. A telegraphic communication so uncertain is of little value, and not worth the cost of laying down. Mr. Forde states that the last section of his cable has been laid down, not in soft ooze, but on "a most irregular and uneven bottom, in places very rocky and exposed," and that he himself wished it to be laid down "in an uniform bottom of about 50 fathoms." The locality was selected by Captain Spratt, of the Royal Navy, the most skilful, accomplished, and careful of all our marine surveyors; and how can Mr. Forde tell whether the eastern portion of the Mediterranean would afford a better answering to his theoretical standard of a perfect bottom! Mr. Forde is not correct in the account he gives of the transfers of the cable originally meant to connect Rangoon and Singapore to the Mediterranean. The Home Government of India, very imperfectly informed, purchased at an enormous cost a cable to run from Rangoon to Singapore. It was shipped, but the vessel was wrecked and the cable damaged before leaving the channel. The Indian Government, by this time better informed about the difficulties of the Rangoon and Singapore line, backed out of the affair, and the cable was transferred to the Mediterranean. That the Indian Government has not the least intention of renewing the project is certain, for four years have elapsed and it has never been entertained. The cessation of the Chinese war has not, as Mr. Forde supposes, had anything to do with it. Were it practicable to establish a telegraphic communication with China, it would be even more useful now with our enlarged commerce, with the civil war in China, and war and commerce with Japan, than in any period of active hostilities with China. The Rangoon and Singapore line is still open to Sir Charles Bright, and, if he finds the coral reef and rocky bottoms which prevail among a hundred isles, and the south-west monsoon blowing boisterously for six months on a leeshore, more easy to deal with than Mr. Forde's shorter section from Benghazi to Alexandria in the comparatively placid Mediterranean, the world will be agreeably surprised. Sir Charles Bright's opinion of this route is confirmed by Mr. Forde, who considers it more favourable than the Mediterranean; but, as these two gentlemen have never visited the locality, I greatly prefer the opinion of the Indian engineers who have, and by which the Government has abstained from meddling with it. Now for the line from Singapore to China. According to Sir Charles Bright's project it is to consist of two sections; the first of these, ending at Saigon, will be about 700 miles long, and 300 miles longer than the average of each of the first two sections of the Mediterranean cable. For about the first half of these 700 miles the cable must be laid among islands, rocks, and coral reefs, for there is no possibility of avoiding them. The second section, ending with Hong Kong, will be about 1,000 miles long, or fully 300 miles longer than the section of the Mediterranean, which has been out of working order for 137 days in three years. Whether the bottom be smooth or stony, Sir Charles Bright cannot say, nor can anyone else; seeing that there are many islets and dangerous rocks in the direct route, the probability is in favour of the rocky bottom. Sir Charles Bright's explanation of the failure of the Dutch cable from Singapore to Batavia is lame and unsatisfactory. He ascribes its failure to the corrosion of the iron by the action of salt water, and the small size of the cable itself. The first fracture took place in a few days after the cable was laid down, and consequently when there was no time for the destruction of the iron by corrosion. The real cause of the repeated rupture of the cable was the inequality of the bottom, and the friction of the cable against coral and other rocks, aided in their operation by currents, a cause which is incurable, and might be aggravated by a heavy cable. Sir Charles and I differ as to the numerical amount of distances. He is the desperate lover of the poet who would annihilate space and time to meet his mistress; the mistress in his case being an electric cable of the newest construction. I make the whole distance from Java to the eastern side of Timor, fronting Australia, some 1,200 miles, and here he may divide his cable into as many sections as he pleases, but, with few exceptions, he will find a coral or rocky bottom, and coral reefs at most of his landing places. I feel obliged to Sir Charles Bright for directing my attention to the soundings lately made by that able surveyor, Captain Denham, between Timor and Australia. I will take his own account of this deep sea. There is, by his own admission, a gap in it of 70 miles, which even the skill of Captain Denham could not fathom. Over this abyss, with heavy cable of the newest construction in hand, he makes a clean spring with the same confidence that he would clear a Welsh brook or a Scotch burn with a running leap. I know nothing in grandeur equal to it, unless it be the achievement of the hero in "Paradise Lost" crossing the burning marl. With respect to the Australian land line, Sir Charles Bright tells us that the country is not a desert from Brisbane northward, such as I represented it, but that "the country is now settled to within 100 miles of the Gulf of Carpentaria." This is travelling faster than even Sir Charles's own cables. The country thus described as already settled, and settled by Britons too, embraces seven degrees of latitude and twice as much of longitude, nearly all within the tropics, with an average heat for the year of 80°, and 100° for the summer. And now I may explain why I have engaged in the present discussion. I did so in consequence of Sir Charles Bright's first letter, promising the establishment of a telegraphic communication with China and Australia in three short years' time. Such a letter coming from an amateur writer would have deserved no attention; but coming from a professional engineer, if mistaken, it was misleading, and merited a refutation. It is right, therefore, that the public should be put on its guard against the schemes of over-sanguine engineers, and therefore it is that I have written. C.

Oct. 19.

Sir,—The points at issue between your correspondent "C" and myself are now reduced to a very small compass. The sea between Timor and Port Essington, "almost every foot" of which he asserted before to be "so deep that it has never been fathomed," is now admitted to be shallow, except for the distance of seventy miles, which, he says, is "so deep that even the skill of Captain Denham could not fathom it." This triumph over the powers of the marine surveyor is altogether imaginary, inasmuch as he did not attempt to take any soundings within seventy miles to the south of Timor. Should it prove that the depth of water in any part of this short space is greater than will admit of the cable being raised for repairs, the loss, in the event of a portion needing to be replaced, would be trifling; but, as I said before, there is no reason to expect any very great depth in this locality. As regards the land line in Australia, the difficulties anticipated by your correspondent are now narrowed to the country between the head of the Gulf of Carpentaria and Brisbane; two-thirds the length,

between the latter place and Port Denison, are now under construction by the Queensland Government. The whole country in question is well known to be the best watered district in Australia, and cattle stations now exist throughout its length to within a short distance of the head of the Gulf. In respect to the line between Singapore and Hong Kong, "C" has abandoned his assertion as to the great depth to be encountered, but states that, for the first half of the section between Singapore and Saigon, the cable must be laid "among islands, rocks, and coral reefs, for there is no possibility of avoiding them." This I dispute altogether, and an examination of the charts will be conclusive that the cable can be laid quite clear of any such imaginary dangers. Nor is the existence of coral any serious objection, except in very small depths and where very strong currents prevail. Your correspondemt appears to be determined not to consult the charts of the seas between Rangoon and Singapore, although he has derived so much information by taking my advice to do so in the case of the Australian section; if he would be prevailed upon to do this, he would find that the cable can be laid in a depth of about forty fathoms over an even bottom of sand, shells, and ooze, as I stated before. I am now described by "C" as an ardent admirer of some poet who is said to have annihilated space and time to meet his mistress. This is because I have corrected some extraordinary exaggerations on his part as to the depth and distance. My measurements have been scrupulously exact, as well as all my other statements in reference to this subject. The possibility of constructing the lines within three years is taken great exception to by "C." I can only tell him that the telegraph cable lately laid by the Indian Government between Kurrachee and the head of the Persian Gulf was manufactured at the rate of fifty miles a week, and at this rate the whole of the proposed cables could be completed, even if the contracts should not be divided among several manufacturers, within two years. The laying of the different sections would proceed upon the completion of the several lengths, so that the last section could undoubtedly be finished within the time named. I have the honour to be, Sir, your most obedient servant,

1, Victoria-street, Westminster, Oct. 15. CHARLES T. BRIGHT.

CORRESPONDENCE.

THE OUTER COVERING OF DEEP-SEA CABLES.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—An amateur telegraph engineer would be somewhat puzzled as to what would be his proper course of action in the choice of a submarine cable (supposing the choice lay with him) if he were to read diligently the various contributions on the subject which appear in your pages; and this with respect to the outer construction no less so than as regards conductor, insulation, and general getting up. With respect to outer protective covering, it will sometimes appear that spiral iron sheathing is a mistake, mechanically and every other way; at another time we will be led to infer that the core (for deep water) may be laid in a nude state, and requires no covering at all; while anon we are told, in all soberness, that longitudinally protecting wires labour under objections that render the adoption of that style of cable wholly inadmissable. Of course your journal cannot be blamed for this heterogeneity of opposing doctrines; it should be open to record all views and opinions; at the same time, however, those which are erroneous, no less so than those that are doubtful, should have their errors exposed, combated, and exploded, if any real advancement is to be made in an enterprise which already, from this and similar causes, lags behind the age.

In last Saturday's impression appeared an extract from the Blue Book on "The External Protection of Deep-sea Cables," which winds up with so glaring an error as to render it absolutely necessary it should go undisputed no longer. It is quite certain "that the necessity for joints to be made in a cable whilst laying and after it is laid down is sure to occur, and must be provided for." This is an important and difficult operation whatever the nature of the cable may be. But we are led to understand that "in the ordinary twisted cable a splice can be made almost as secure as the original cable;" and this probably need not be quibbled about, as, by virtue of its very structure, it offers peculiar facilities for making good joints, if the maker is anything of a workman. What follows, however, must be taken exception to, as the implied difficulty in one case is really no greater than in the other. "Longitudinally covered cables will necessarily present greater difficulties. * * * When three or four wires are included in the same covering, a defect in any one wire renders it necessary *to cut the entire cable*, and this difficulty is, no doubt, an objection to this kind of cable." Well, if it were "necessary to cut the entire cable," it certainly would present an insuperable "objection to this kind of cable." But this is altogether a mistake. It must be a queerly made cable that necessitates complete severance in order to join up one broken wire, and seems to imply such a conglomeration of materials, thrown together without system or order, as to render it as difficult to find the severed ends of the wire as to discover a needle in a bottle of hay; there is probably not a longitudinal cable yet invented to which this objection is strictly applicable; if there be, it certainly has not seen daylight yet. So far as our own cable is concerned, there would not be the slightest difficulty in joining the core, or the whole cable for that matter, at sea; while, so far from the fact of the severance of one of the external wires rendering it necessary to cut the whole cable, we beg to say that we could join up the broken wire with the most perfect ease, and in as short a time as that required in splicing a spiral cable; and would guarantee the cable to be as strong, if not stronger, at that particular point as at any other part of the unbroken line. Moreover, the extreme lightness of our patent cable gives it an immeasurable advantage over heavy spiral iron cables in the making of joints; it could be more easily managed, and would incur no risk of undue weight falling upon the core, as must inevitably be the case with the other.

We may be allowed to say also that this style of cable, although only weighing ·875 tons per mile in air, is nevertheless the strongest cable for its weight and diameter yet invented, having a tensile strength equivalent to upwards of 11,000 fathoms of its own length in sea-water, and is wholly free from the slightest liability to kink.

It is much to be regretted that erroneous notions should be set afloat on matters of so much importance. It is enough to bewilder and bemuddle impartial men who are striving earnestly to arrive at a correct notion as to the best kind of cable for deep seas. There has been enough said, and justly, as we think, to make the most courageous rather nervous in the matter of the old style of construction, while the same individual may be driven to his wit's end to know what to adopt if equally apparently valid objections be urged against another style obviously well fitted to supersede the old one; and hence we thought it high time to challenge an absurd statement which has not a tittle of foundation in fact, but which has nevertheless gone undisputed these four or five years.

We are, Sir, yours respectfully, WELLS & HALL.

MAGNESIUM AND ITS LIGHT.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In your article on the magnesium light I observe that you mention the principal photographs which have been taken by its aid, and the fact also that the President of the British Association sat for his portrait during the lecture delivered by Dr. Roscoe at Bath; but you have omitted the name of the photographer. As I believe, I was the first to bring this metal into actual use for photographic purposes, and as you refer only to those photographs which I have taken, I think that I am at least entitled to have my name included with those mentioned who have interested themselves in practically demonstrating the value of the magnesium light for photographic and other purposes.

The experiment you refer to, as comparing the magnesium with the electric light, was made by myself, partly for the purpose of testing the value of Mr. Grant's lamp for burning the wire, and also to compare the two lights, which I had never previously had the opportunity of doing.

The electric light from sixty cells of a Grove's battery no doubt has greater illuminating power than the two burning points of wire; but the comparison was very satisfactory, as showing the superior *quality* of the magnesium light, as it was admitted by many present to be much whiter and purer than the electric light. A proper comparison of the two lights has yet to be made. For instance, what number of points of wire, burning at the same time, should be considered a fair proportion to the sixty cells of Grove's battery? Yours obediently,

Manchester, 19th October, 1864. A. BROTHERS.

TELEGRAPH CLERKS' SALARIES AS SECURITY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—A great benefit may be effected through the favour of your publishing a few words respecting an order just issued by a telegraph company, greatly detrimental to the interests of a large staff of employées. It is, giving notice that only a fortnight's salary is to be paid for the ensuing month; the remaining sum to be kept in hand, it is said, as a security against defalcations. This order, whatever may be its true origin, is, to say the least of it, unfair for the *present* employées, who had no idea of such a proceeding on entering the service, and they have no course to pursue but submit or resign. Many a poor manipulator, with a low salary, is expected to maintain a respectable appearance, and he is required to act with judicious economy to enable him to do so with his *regularly* paid stipend, and he will, by having such an amount stopped, as proposed, experience considerable inconvenience. The clerks are subjected to too heavy fines for errors, to require any further deductions. And I beg to suggest that, if even it is according to law, and supposing the money could be spared (although a fortnight is a long time), no company of recent formation should absorb the wages of its hard-working employées. I trust the order may be rescinded before its evil effects are visible. I have reason to believe that this simple statement will be endorsed by every telegraph clerk, and others, who peruse your journal, will accord us their sympathy.

Manchester. H. K.

A LIGHTHOUSE ON THE AFRICAN COAST.—The lighting up of Cape Spartel, the first lighthouse erected in the dominions of the Sultan of Morocco, took place on the 15th instant. The diplomatic corps and Governor of Tangier and suite were present. The tower is 79 feet high, with a fixed light visible 20 miles at sea.

TELEGRAPHIC NEWS.

Atlantic Telegraph Company.—The Iris, 25, sailing frigate, having been lent to the Atlantic Telegraph Company, instead of the Venus, 26, to be used in conveying on board the Great Eastern the Atlantic telegraph cable, has had the boilers which were temporarily placed on board removed by means of the floating shears, and will proceed round to the Thames, for the purpose of shipping the first portion of the cable.

Telegraph between Bombay and the North-West.—The telegraph line is now nearly complete between Bombay and the North West. A distance of thirty miles or so to the North of Gunpoorah now only remains to set up. The completion of the line had been delayed by the difficulties experienced in procuring carriage for the conveyance of material, both north of Ahmedabad and south of Agra.—*Homeward Mail.*

Opening of the Port of Avlona.—The *Levant Herald* of the 5th inst. observes :—"The Government, we understand, are about to declare Avlona a free port. Being the point of junction in Turkey of the telegraphic cable which connects the East and West by way of Italy, and being about also to become affiliated with the intended network of railway communication in European Turkey, the town and port of Avlona seem destined, beyond doubt, to a future of great commercial activity and importance."

The Anglo-Indian Telegraph.—The following important message, dated Bombay, 2nd October, was telegraphed from Suez on the 25th instant, at 1.30 p.m., but the route by which it reached that place is unknown, there being no mail from Bombay between the 29th of September and the 14th October :—"The Persian Gulf telegraph cable has been repaired. The land line is completed from Bushire to Teheran, and messages have come through to Bombay in twelve hours. The extension from Teheran to Bagdad will be finished next month, but the disputes on the frontier prevents communication with the latter city."

East Indian Railway Company.—In the half-yearly report of this company, to be presented to shareholders on the 31st instant, we find that in the North-Western Provinces the telegraph is in working order from the Kurrumnassa to Delhi. There are 52 stations at work, from which the number of messages sent amounted to 194,205, as against 124,878 from 45 stations in the previous half-year; the receipts from private messages amounting to Rs. 8,282-11-0, as compared with Rs. 8,935-3-0 in the previous half-year. On the Jubbulpore line, the engineer states that he has not, to the date of his return, received any official information of the despatch of the materials from England, or of the patterns of the various parts; but he believes Messrs. Waring Brothers & Hunt's agents have been advised of the shipments. Upon the arrival of the invoices, no delay need occur in the erection and working of the telegraph.

Supper and Presentation.—E. Gilbert, Esq., Superintendent of the Northern Division of the Electric and International Telegraph Company, was, on Friday evening, the 14th instant, entertained at supper by a select party. The occasion was his leaving the service of the Company, after seventeen years' labours, on accepting the appointment of Telegraphic Superintendent for the Scottish North-Eastern Railway Company, who are shortly to take the management of their telegraphic system into their own hands. Mr. Midgley, of the Telegraph Company's Office, presided, and Mr. W. G. Matthews, of the engineering staff, was croupier,—both gentlemen discharging their duties agreeably and efficiently. In the course of the evening, Mr. Gilbert was presented, through the chairman, with a valuable diamond ring, and handsome editions of "Chambers's Encyclopædia," and "Poe's Works." Mr. Gilbert, in accepting these tokens of regard, addressed the assembly in feeling terms, adverting briefly to his long connection with the Electric Telegraph Company, thanking his coadjutors for their invaluable assistance during that period, expressing the satisfaction it gave him to be so hospitably entertained, and to receive so marked an expression of good-will from those among whom he had laboured, but whom he was about to leave, in order to take the management in a more extended sphere of usefulness.

War Department Lectures at Chatham.—The following is the programme of the lectures to be delivered to the officers and men of the Royal Engineers at the Royal Engineer Establishment, Chatham, by Professor W. Pole, F.R.S., Professor F. Abel, F.R.S., Mr. F. Jenkins, and other eminent lecturers who have been engaged for that purpose by the War Department :—Oct. 18, "The Strategical Defence of England," by Capt. W. Hichens, Royal Engineers; Oct. 25, Nov. 1, and Nov. 15, "Railways and Railway Locomotives," by Professor Pole; Oct. 27, "Steel—Results of recent Researches on the Production and Constitution of Steel—English and Continental Steel Manufacture—Homogeneous Iron—Production of Steel by the Process of Bessemer, Krupp, Parry, &c.," by Professor Abel; Nov. 4, "Military History," by Capt. F. R. Chesney, Royal Engineers; Nov. 18, "On Copper, Lead, Zinc, Tin, Antimony—Alloys of those Metals—Conditions which regulate their Quality and Applications," by Professor Abel; Nov. 22, "On Gun Cotton, &c.—its History—its Properties, as compared with those of other Explosives—recent Improvement in the Manufacture and Application of Gun Cotton—Results of Experiments instituted with it in England," by Professor Abel; Nov. 24, "On Building Stones—their Characters and Qualities—Causes of the Decay of Building Stones, and Processes applied to their Preservation," by Professor Abel; Nov. 29 and Dec. 1, "On Signalling Instruments used on Land Telegraphic Lines," by Mr. F. Jenkin; Dec. 6, "On Signalling Instruments for Submarine Cables," by Mr. F. Jenkin. The following papers are also to be read and discussed on the dates named :—Oct. 21, "On Centralized Defence," by Capt. H. Hichens, Royal Engineers; Oct. 28, "On the Blasting of Chalk Rock by Gunpowder," by Lieut. T. Fraser, Royal Engineers; Nov. 4, "On some Experiments in Blasting in Brickwork," by Lieut. H. P. Knocker, Royal Engineers; Nov. 11, "On the different Electrical Methods of Firing Gunpowder," by Capt. R. M. Parsons, Royal Engineers; Nov. 18, "On Embankments for Retaining Water," by Capt. W. D. Marsh, Royal Engineers; Nov. 25, "On Gun Cotton for Blasting Purposes," by Lieut. Col. J. W. Lovel, C.B., Royal Engineers.

MISCELLANEA.

The Need of Means of Communication between Passengers and Guards of Railway Trains.—A reverend gentleman living at Gloucester has communicated the following extraordinary narrative to our (*Western Daily Times*) correspondent in that city :—"Travelling from London to Gloucester on the 19th instant by the express train, which left Paddington at 11.45, a scene took place which shows (if any additional proof were required) the importance of establishing some means of communication between the passengers and the guard. I had a second-class ticket, and, anxious to avoid the inconvenience of changing at Swindon, I took a seat in the through carriage to Gloucester. My fellow-travellers were two ladies, who were going, I think, into South Wales, and I had just settled snugly in a corner, and prepared for a few hours' quiet reading, when my attention was attracted by the entrance of a man in a sailor's dress, whose bloodshot eyes and savage mien told of drunkenness. I was on the point of seeking the guard when the fellow suddenly left the carriage, and, the guard coming up at the moment, I requested that he would not allow him to return; but to my surprise, almost at the instant of starting, the fellow burst into the carriage, followed by the guard, who warned him that if he did not behave properly he would be left on the road. Now, this was not a pleasant prospect. We were to run to Swindon without stopping, and were to be all this time caged with a drunken ruffian. But there was no help for it. In the course of some ten or twelve minutes the fellow vehemently proclaimed himself 'a Southern privateer, and an enemy to the —— English.' Rising from his seat he staggered over the feet of the ladies, and, confronting me, demanded what I had to say, threatening to 'smash my skylights' if I did not tell him my opinion, and flourishing his huge fist in my face by way of warning. I quieted him for a few minutes by getting him to tell us something of his early life. He said he was an Englishman, had run away from home when a boy, had gone to South America, and that when the war broke out he had taken service in a Southern privateer. His tale was mixed up with such oaths and blasphemies, that I was glad to withdraw my attention, whereupon, to my dismay, he produced a bottle of strong drink of some kind, and swore he would 'treat the company.' He put it to his mouth by way of showing us how to do it, and took a pull so hearty and so long, that he swallowed one-half of the contents. Declaring in words not to be repeated that the man or woman who did not drink should 'catch it,' he presented the bottle to each of the ladies. Having spent about ten minutes coaxing and threatening them, he turned to me. I expected I was 'in for it,' but upon my refusal he only expressed contempt for the 'old Jinnies,' and took the remainder himself at one gulp. This over, he prepared for smoking, and seeing it alarmed us, he amused himself for some time in throwing about half-burnt matches. He had learned the 'free and easy' habits of American society, and spat with an accuracy of aim that was undeniable, for he made my face the target on two or three occasions. When he had satisfied himself upon this head he grew heavy, and, stretching out his legs so as to take up one side of the carriage, he fell, as we delightedly supposed, into a sleep. I settled down to read, and had been, perhaps, ten minutes or so employed, when I was startled by a shriek and a spring from one of the ladies, and on looking up I saw, to my terror, that the fellow had suddenly opened the window, and had so far succeeded in getting out that, but for the presence of mind and courage of the lady, who had seized him by the hair, he would have been under the wheels in another moment. By uniting our efforts we were able to drag him in, but for full a quarter of an hour he fought and tore like a savage, leaping at the window, and we restraining him, till at last he was compelled to desist through sheer exhaustion. What a situation to be in! He then adopted a line of retaliation which was so grossly indecent and outrageous that I dare not describe it. The poor ladies (whose conduct exceeded all praise) huddled together into a corner, while I stood in front guarding them with a stout umbrella. I confess if at this moment the scoundrel had attempted to get out of the window again, I think I should have allowed him his own way. Providentially the engine-driver found it necessary to stop at Wantage-road, and I succeeded in obtaining aid, and had him removed. If we had been compelled to run all the way to Swindon, Heaven—who preserved us—only knows what might have happened." The writer adds :—"Now, I think you will agree with me when I say that it was a shameful outrage to put such a ruffian into our carriage, or into any carriage with civilized people. True it is we were only second-class passengers, but that is not sufficient reason—at least to us—why we should have been terrified almost out of our lives, and disgusted to loathing by the conduct of this drunken scoundrel. Never did I feel so utterly helpless. I put my head out of the window, and

I called till I became hoarse, and although the guard was within a few yards, we might have been murdered for any help he could have rendered, and all this in open day, and on the Great Western Railway. Perhaps if the wives and daughters of some of the directors had been in the carriage something might come of it, but of course as they travel in the first-class such a thing is not likely to happen to them; and yet poor Briggs's case shows us that even there people are not always safe. How long will the public bear this kind of thing? Surely it is our duty to call upon Government to compel the directors to action."

Fuller's Telegraph Computer.—Until this little machine has been seen it is scarcely possible to understand how completely a mechanical contrivance can be made to do all kinds of computations. Perfectly simple and intelligible in plan, it is capable of solving almost any problem in arithmetic. At one operation it does both multiplication and division. Interest is calculated to the most perfect nicety. The possessor of the machine may guage the contents of any vessel in a minute. The most intricate calculations are worked with the most perfect ease and simplicity. The principle upon which the machine is based is that of the ordinary sliding-scale, but its application is made completely intelligible and easy, while the form of the machine is most convenient for all office purposes. The peculiar advantages which this instrument possesses over other tables are thus enumerated by the proprietor:—It enables a person to calculate instantaneously—1. Interest upon any sum, or any kind of money, at any rate per cent. for any length of time. 2. The exchange of money with any country. 3. The exchange of weights or measures with all nations. 4. The exact loss or gain on cash, stocks, shares, real or personal property, at every possible fractional rate. It is invaluable as a check to even the best accountant, to verify and prove work done by another process. Very frequently inventors claim for their inventions powers which, on careful examination, they are not always found to possess. This, however, is not the case with Mr. Fuller's computer. It readily responds to every demand in the arithmetical way which is made upon it. We have only pointed out some of its advantages. Indeed, the purposes to which it can be applied are so numerous that it would be well-nigh impossible to enumerate them. No accountant's or merchant's office, or bank, or any place where rapid calculation is desirable, should be without it.

The Electric Light for Illuminating Large Buildings.—Professor Seely, of New York, has obtained a patent for an electric light on a principle which very strangely does not seem to have been thought of before as the best and by far the most economical mode of producing light by electricity. He employs the current generated by an ordinary frictional electrical machine, and obtains the light by interrupting the current. It has long been known that a very brilliant and steady light might be procured in this way, but the objecton to its use is the uncertainty in the action of the frictional machine. Dry air is a very poor conductor of electricity, and when a machine is excited in such an atmosphere the electricity will remain in tension for a considerable time. But moisture in the air conducts the electricity away, and when the moisture reaches a certain point the fluid is removed so rapidly that the machine will not work. Professor Seely's invention consists in devices for making the action continuous in all weathers. This is effected by surrounding the machine with a glass case, and keeping the air within the case dry by means of chloride of calcium or other hygroscopic substance. It has been observed that when the conductor of an electric current is interrupted in a way to draw a spark across the break, the brilliancy of the spark varies with the material by which the conductor is terminated at the break. Professor Seely is now engaged in experiments to ascertain what material will produce the most intense light. If the apparatus works according to anticipation a building may be lighted without any current expense, except the small power required to turn the electrical machines. As in mills driven by water there is always a surplus of power during the winter months, the only time when lights are required, there would be no expense for this light except the first cost of the apparatus, which would be quite moderate.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2607. A. Reynolds, improved mode of manufacturing sulphuric acid.

2616. J. Scarisbrick, improvements in apparatus for signalling on railway trains.

2634. W. Clark, improvements in apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1755. E. Burstow, an improved apparatus for communicating signals in railway trains.

2083. J. S. Farmer, improvements in the construction of railway signals, and improved means of signalling between passengers and guards of railway trains.

2165. J. Barber, improvements in communicating, watching, and signalling throughout railway trains.

NOTICES TO PROCEED.

1508. M. E. Bowra, improvements in tubes and caps made of india-rubber or other known elastic gum, and in their application to various useful purposes.

1538. W. J. Pughsley, improvements in obtaining sulphuric acid from the refuse "pickle" used in tin plate works, and also from sulphate of iron or "green copperas."

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

2656. L. Pulvermacher, improvements in apparatus for the production of galvanic and magneto-electric currents, and in machinery employed in making some of the apparatus.—October 23rd, 1861.

PATENT ON WHICH STAMP DUTY OF ONE HUNDRED POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

2707. J. Macintosh, improvements in the construction and laying of telegraphic cables.—October 24th, 1857.

COLONIAL PATENT.

524. J. Haworth, an improved method of conveying electric signals and telegrams without the intervention of any continuous artificial conductor.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good .... 2/ to 2/3 per lb.

India Rubber.

Para, first quality	1/7 to 1/8	„
second „	1/4 to 1/5	„
third Negro-head	1/1 to 1/2	„
Java and Penang	1/2 to 1/4	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	104½ to 105	—
100	Submarine Telegraph, registered	all	45 to 50	—
all	Do. scrip	all	⅜ to ⅝	—
5	United Kingdom Telegraph .	3	1 to ½ dis.	—
10	Mediterranean Extension Tel. .	all	8 to 8½	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	8⅜ m.	—

TO CORRESPONDENTS.

Experimentalist.—The best covered wire for coils may be obtained of Messrs. Wells & Hall, of Mansfield-street, Borough-road, S.E.—See their advertisement.

A Patentee.—It is an infringement to make a patented article for use or sale, though the said article be never used or sold.

Enquirer.—The character of the letters in which messages are printed by Hughes' printing instrument is sans-serif, having the appearance of the following sentence:—PROFESSOR HUGHES IS NOW IN FRANCE.

J. Lamb.—Henri V. Regnault, the French physician and chemist, was "the first to demonstrate that the latent heat of steam diminishes as the sensible heat increases, but in a slower proportion."

R. A. P.—There is little doubt of the existence of electricity in the rays of the sun and other sources of light; but it is not of quantity or intensity sufficient to affect your experiments. Mr. H. Kevil read a paper on the subject at the Bath meeting of the British Association, and demonstrated the presence of electricity in the rays of the sun by suspending needles in exhausted receivers and exposing them to the rays of light, when deflections of the needle, varying from 2 to 10 degrees, were apparent.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

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THE TELEGRAPHIC JOURNAL.

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THE ANGLO-INDIAN, AUSTRALIAN, AND CHINESE TELEGRAPH.

Now that the correspondence in the columns of the *Times* on this subject has ceased, we may be allowed to ask—What has been gained by the controversy? A cursory glance at the origin of the discussion may enable us to convey a more intelligible narrative of the arguments than could be communicated otherwise. On the 9th of October Sir Charles Bright wrote the *Times* that "a telegram had been received by Sir Charles Wood from Colonel Stewart at Constantinople, dated the 7th instant, conveying the substance of a message from Colonel Kemball at Bagdad, of the 3rd instant, reporting the reinstatement of telegraphic communication between Bussorah and Kurrachee, and announcing the receipt at Bagdad of a telegram from India, dated the 27th of September." After conveying this information, Sir Charles Bright proceeded to a description of the works in progress in connection with the Indo-European telegraph, and concluded his letter by the following observation:—"The Indian telegraphs, which connect together Calcutta, Bombay, Madras, Delhi, and all the principal towns in India, are now advanced eastwards as far as Rangoon, and the routes thence to China and to Australia, by way of Singapore, Java, and Timor, are almost entirely in comparatively shallow water, so far as the submarine part of the line is concerned, and do not otherwise offer any difficulty which should prevent our having daily telegrams from Hong Kong, Melbourne, Sydney, Adelaide, and Brisbane, within three years from this date."

This latter clause appears to have given umbrage to an anonymous critic, signing himself "C," who twits Sir Charles Bright with "imaginative" and "poetical" conceptions of the enterprise; takes exception to his anticipations; disputes the practicability of a line of telegraph by way of Singapore to China in one direction, and Australia in the other; and asserts that, in order to realise the comprehensive scheme, the engineer "will have to lay down, sometimes among coral reefs and sometimes in unfathomed sea, 5,000 miles of submarine cable and 2,500 miles of land-wire, making in all a telegraphic line of between 7,000 and 8,000 miles in length."

It is unfortunate for "C" that the data on which these conclusions are based are invalid. In the first place, he affirms that the proposed line between Rangoon and Singapore will of necessity be laid in great part on a coral bottom. This asseveration is directly at variance with the Admiralty chart (which indicates a suitable course over sand, shells, and ooze), and is contradicted by Mr. Forde, whose long experience in these matters gives weight and force to his opinion. Regarding this very section Mr. Forde observes, "The depth and nature of the sea bottom between Rangoon and Singapore are more favourable for laying and maintaining a cable than" the sea-bed "between Malta and Alexandria." Again, "C" urges that the cable to connect Singapore and Hong Kong, of an estimated length of some 1,500 miles, must be laid in very considerable depths in a locality frequently disturbed by typhoons; whereas by the route contemplated the distance will be increased nearly 200 miles, in order that a landing may be effected midway at Saigon, while the utmost depth in which this line will be laid does not exceed 50 fathoms.

One of the first purposes of a telegraph engineer engaged in submarine work is to ascertain depth by soundings, and afterwards to avail himself of a route which will admit of the cable being recovered for repairs in case of accident, for the art of telegraphy has not yet reached that stage of perfection which will allow of indifference to this precaution. The scheme proposed is, therefore, to proceed in 50 fathoms of water from Rangoon *viâ* the coast of the Malay peninsula to Singapore, and from that locality to extend divergent lines by the coasts of Cochin China and China Proper to Hong Kong in one direction, and through Java, and thence by the Island of Timor to the Gulf of Carpentaria in the other. Sir Charles Bright, in anticipation of any emergency, has selected a course as suitable for the proposed telegraph, and believes it to be "almost entirely in comparatively shallow water, so far as the submarine part of the line is concerned;" but herein "C" differs. Where he finds deep water he conjures up disasters, and where he discovers shallow water he predicates misfortunes. Exception is taken to the Singapore-Hong Kong section on account of great depths, and objection is urged to the Singapore-Batavia section on account of the shallow sea. It happens singularly enough that in his study of this subject "C" has omitted to consult the best authorities, or to avail himself of the information imparted by the most recent Admiralty surveyors; hence, his statements are unreliable, and his deductions from them erroneous. From Java, "C," in his simplicity, maps out a course direct from Batavia, evidently unaware of the long-existent line throughout the island. Between Timor and the Australian coast "C" says the sea intervening is "considered by experienced mariners to be one of the deepest in the world," while the engineer affirms that the water is shallow with the exception of about 70 miles south of Timor."

On the Australian coast "C" selects Cape York as the landing-place for the cable, and says that "a land-wire will have to be carried 2,500 miles from that point to Brisbane, Sydney, Melbourne, and Adelaide, to complete the entire undertaking." It is fortunate that the greater part of this length is already at work, all the cities enumerated being connected with each other at the present time.

"The distance from Timor to Port Essington (one of the intermediate stations on the route to the Gulf of Carpentaria) is from 700 to 800 miles, and the cable to form this connection," says the critic, "will have to be submerged in water so deep, that it has never been fathomed, and, for what any one knows, is unfathomable." Here, again, "C" is at fault. The distance is but (taking the highest estimate) 500 miles; while the whole of the sea between the Australian coast and Timor, with the exception of a portion varying from 40 to 90 miles from the island, is under 80 fathoms in depth, the greater part varying from 30 to 40 fathoms.

The foregoing may be considered the substance of the arguments. It is apparent that in the outset Sir Charles Bright sought only to inspire public confidence in one of the most important undertakings of modern times; while "C," from some motive, on the nature of which it would be unbecoming to speculate, has endeavoured to undervalue the statements and anticipations of the eminent engineer. It not unfrequently happens that a critic finds himself in a dilemma from having ventured too far on other men's domains. In his last letter "C" evidently acknowledges the peculiar predicament in which he finds himself involved, and thus explains why he engaged in

the present discussion:—"I did so in consequence of Sir Charles Bright's first letter, promising the establishment of a telegraphic communication with China and Australia in three short years' time. Such a letter coming from an amateur writer would have deserved no attention; but coming from a professional engineer, if mistaken, it was misleading, and merited a refutation." "C's" apology is equally unsatisfactory as the statements previously made, for it is qualified with an "*if*," which deprives his former observations of all weight, and renders his conduct in guarding the public against the schemes of over-sanguine engineers a work of supererogation. Throughout this controversy Sir Charles Bright has evinced a disposition to bear with his critic's shortcomings, and to afford him every information in order to enable him to become better acquainted with the subject—a course which commends itself to our approval. We have gone carefully over the arguments on both sides, comparing the estimates and soundings with the maps and charts, and can endorse the concluding observations in Sir Charles Bright's letter of the 15th ultimo, wherein he remarks:—"My measurements have been scrupulously exact, as well as all my other statements in reference to this subject. The possibility of constructing the lines within three years is taken great exception to by "C." I can only tell him that the telegraph cable lately laid by the Indian Government between Kurrachee and the head of the Persian Gulf was manufactured at the rate of 50 miles a week, and at this rate the whole of the proposed cables could be completed, even if the contracts should not be divided among several manufacturers, within two years. The laying of the different sections would proceed upon the completion of the several lengths, so that the last section could undoubtedly be finished within the time named." Having reviewed the correspondence, we again ask—What has been gained by the discussion? An answer seems difficult, but we have one—It has inspired public confidence in the gigantic work, has strengthened the reputation of Sir Charles Bright as a telegraph engineer, and proved to the world the utterly unreliable nature of anonymous criticism.

ON RAILWAY ELECTRIC SIGNALLING.

By W. H. Preece, Assoc. Inst. C.E.

The attention of railway managers to the power of electricity in facilitating and protecting the working of their traffic is becoming daily more fixed. The many accidents that have occurred which could have been obviated by the adoption of modern electrical appliances, the constant and repeated recommendations of the Government inspectors to improve the system of working, but, above all, the freedom from calamities which characterise those lines that have availed themselves of the services of the electric current, and the constant repetition of accidents upon lines that are deficient in these useful auxiliaries, have fairly produced a reformation in the opinions of our railway authorities. Electricity is in the ascendent. It is a power which, thoroughly understood and properly applied, can accomplish an immense amount of service in the working of a line. It supplies the only means that science possesses to enable us to carry out the "block" system in its entirety.

It is curious to observe how the term "*block*" system has become rooted in the language of railway lore. It cannot be said to be strictly correct. The "*space*" system, as opposite to that of "*time*," would have been more accurate. It probably arose from the necessity of "blocking," or pinning the needle over in the earlier systems, to protect the line, or what is now called "block" the line from following trains. The period which elapses between the passage of one train and another depends upon the distances at which the signalling stations are placed apart, and if these be made to correspond with the maximum amount of traffic likely to arise on any particular section of the line, the delay, if any should arise, would be reduced to a minimum. The London and North Western maintain their signalling stations at intervals of two miles. On the Charing Cross extension of the South Eastern Company they are less than a mile apart.

The "block" system is the plan by which trains are maintained apart by a certain and invariable interval of space, instead of an uncertain and variable interval of time. Most railways have hitherto been worked on the time system. Experience has proved this to be unsafe. The block system is the only safeguard against collision. Colonel Yolland, in his evidence at Egham, stated:—"The danger of running trains at intervals can only be obviated by the block system of telegraph."

Where fast express and slow goods trains are travelling over the same line, now through a thick fog, now up a wet incline, it is impossible to maintain that rigid interval of time which is essential to prevent collision. When a creeping mineral train breaks down in a long interval between two stations, it is frequently impossible for the guard to go far enough back to stop an advancing fast train from dashing into it. When, however, two trains, however rapidly or slowly they may be running, are invariably kept apart by an interval of two, three, or four miles, such accidents are impossible; breaksdown are harmless, and no mischief can occur beyond delay. Railway companies are very chary of introducing the block system, upon the plea that it produces delay, but practice shows that the delays it produces are not so excessive as those under the old plan. Instead of keeping the danger signal on for five minutes, and the caution for five minutes more after the passage of each train, the signal can be lowered to "all right" immediately the train is signalled out of its length, and trains can run with perfect safety at intervals of two minutes, or even less.

It is also urged against the block system, that anything which removes the responsibility from the driver, and distracts his attention from a straightforward look-out, must be objectionable. Now, those who raise this objection, ignore as an advantage on the open line what is admitted to be essential in a long tunnel, where the greatest caution is required, and where, when full of steam, the look-out is confined to the length of the driver's nose. If the system is advantageous in a dark tunnel, where the driver trusts entirely to the faithfulness of the "block," surely it must be useful where he has the advantage of the light and a clear look-out! But how does it remove responsibility from the driver? The signals are the same, and he has but to follow them, whether they are lowered at an interval of ten minutes, or after intimation that the section of line in front is cleared. Those who have introduced the system, and have received a practical exemplification of its merits, are found to advocate it strenuously, while its opponents are almost invariably found to have never used it at all. Practice makes wonderful changes in settled opinions.

I carefully avoid the use of the word "telegraph," in speaking of railway signals, because it is so difficult to induce railway authorities to associate the construction, the working, and the complication of the ordinary telegraph with the simplicity and the action of electric signals. A great amount of misconception exists as to the difference between the two. The following remarks occur in a leading article of the *Railway News* (Oct. 8, 1864), when dilating upon Colonel Yolland's remarks upon the Egham accident:—"The Government officer recommends the adoption of the electric telegraph as a ready means for keeping an interval of space between following trains. Under this system, the station in advance telegraphs back that the line up to that station is clear for a train to travel up it. But the electric telegraph itself is at best merely an auxiliary; and it is even possible that the 'affirmative signal'—which it is to a certain extent—of the electric telegraph may induce a false security on the part of the driver, and lead to serious

accidents, in the event of an incorrect telegram being sent along the line. It is very easy for a telegraph boy to make a mistake in a signal, and to send the message of 'all clear,' when the line is really obstructed."

Now these observations are very true for cases where the electric telegraph worked by boys is employed for signalling purposes, but they are totally inapplicable to electric signalling, properly speaking. In the first place, electric signals are never entrusted to a boy—they are invariably placed in the hands of the signalmen themselves. Telegrams do not pass to indicate that the "line is clear" or "blocked;" a permanent signal is made behind each train to protect it from any following train. The proper way to consider electric signals is to treat them precisely as distant signals worked two or more miles off. Thus, when a signal is put up to protect a train, it cannot be taken off until the train arrives at the end of the two miles. The idea of imparting a false security to the driver, or lessening his responsibility, is no greater with electric than with mechanical signals. The action of each is similar, only in the one case we use electric and in the other muscular force. Any system of signalling that requires the passage or spelling of words, or the asking of questions, must be based upon an infirm foundation. If any lines do adopt such a system, the sooner it is abandoned the better will be the security of the passengers. It is the adoption of imperfect systems of signalling that has principally caused the slow advancement of electric signalling, and prejudiced the minds of railway managers against its use. They have attempted to accomplish in a telegraphic manner what can only be done perfectly in a railway fashion. That electric signalling can be performed securely and promptly in a railway manner, will, I trust, be fully evident from the succeeding column.

The chief object to be attained in carrying out the block system is that of making the next station practically a distant signal, to protect the line from any following train, and on single lines from any meeting train. This could be easily carried out, were it mechanically possible to work a signal two miles off, and blow a whistle that could be heard that distance; but as this is impracticable, electricity has been made use of to supply the want. The moment a train enters a section of line its approach is announced to the station towards which it is going by the sounding of a bell or gong, and the line behind it is protected from any following train by a danger-signal being raised and maintained in that position until the train has passed clear of that section. This, it will be perceived, is just what is done by a distant signal within sight: the train approaches, the signal is put up, and it is not lowered until the train is clear. It is a very simple operation to perform, when the mechanical contrivances for effecting it are within sight and within reach; but great precautions are required when that subtle force, electricity, is used.

There have been many attempts made upon various lines to introduce a perfect and reliable system, but that we have not yet succeeded in obtaining the best plan is evident from the fact that scarcely two of our railway companies adopt the same system.

(To be continued.)

REPLY TO "CHEROKEE."

By Uncle Sam.

Lest it should be said that "Cherokee," the slashing Red Indian of the *Telegraphic Journal*, of the 1st of October, cannot be answered by any of your correspondents, I have ventured to reply to his article.

Firstly, I would remark that in the algebraic formula he quotes, the symbol f represents, not *electro-motive force*, but the *strength* (intensity) *of the current*—that is, the amount of work the current is capable of doing over and above the work expended in overcoming the resistances of the circuit. E is the *electro-motive* force of the combination composing the battery, or the difference of tension of its poles—the force which urges the current forward.

The formula itself represents the *strength of the current* in a battery of n (any number of) cells on "short circuit"—that is, connected by a short and thick wire, the resistance of which is so very small as to be inappreciable.

The first law quoted from Wheatstone may not arise from the formula, but if "Cherokee" disbelieve it, let him experiment for himself, and he will find it quite true.

The second law is also perfectly true, and I think not "clumsy." Experiment is hardly necessary to prove it, for it commends itself to one's common sense, that if a conductor is enlarged and shortened, its resistance is decreased.

Thus, the first difficulty vanishes when the law and the formula are correctly stated. I am not fortunate enough to have been presented with a copy of "Noad," so that I cannot say who is responsible for the error.

"Cherokee" next questions the law that a battery will do the most work when the external resistance is equal to the battery resistance. Part of his difficulty arises from the error which I hope I have set right, and I think the remainder will be lightened, if not removed, by considering the law to refer to a *given battery*, in which all the elements are fixed, so that neither R, D, nor S are variable. The law then comes out true, though, as I have elsewhere shown, it is deceptive in practice, or at least in telegraphy.

I confess I do not see where "Noad" is wrong in the next case. Nothing is more easy to prove experimentally than that when the external resistance is inappreciable, one cell will do as much work as fifty—that is, as much *exterior* work, such as deflecting a needle, because each cell brings its own resistance with it, and the additional electro-motive force of each one is employed in overcoming its own resistance.

n E is a tension, not the same as E, but one n times as great. The internal (battery) resistance is also n times as great. But in the formula now given, R does not represent the same thing as in the first formula. It now stands for the total resistance of the battery, instead of the specific resistance of the fluids in the cells. Who is accountable for this confusion?

Give R its proper value, and I think "Cherokee" will acknowledge that his difficulty vanishes, for r, the exterior imperfect conductor, must have clearly, judged by common sense even, less comparative effect in increasing a resistance, R, than one n times as great. To employ the same style as "Cherokee" himself uses, an inch makes comparatively more difference in the length of an article in your journal than in that of an Atlantic cable.

Finally, is not he making fun of us? if not, will he explain his algebraical puzzle?

The Effects of Anæsthetics on the Human Constitution.—All anæsthetics act on the system similar to alcohol, the smallest effective dose produces exhilaration, a little more great excitement, which in different individuals manifests itself in a great variety of ways, a greater dose produces sleepiness, and the maximum dose perfect insensibility. The difference between nitrous oxide, and the other anæsthetics is, that the first being a supporter of combustion and respiration, stimulates the nervous system, and produces an increase of vitality, the others being non-supporters of combustion and respiration, depress the nervous system and bring vitality below the standard, and both with the same final result, *perfect unconsciousness;* the difference only is that the unconsciousness produced by the increase of vital action is harmless, and the same result produced by the depression of vital action is injurious, and may prove fatal; in other words, that the excitement or unconsciousness following the use of nitrous oxide is harmless in its results, and the excitement or unconsciousness following the use of ether or chloroform is connected with danger. It is a fact stated by Dr. Colton, who has administered the nitrous oxide to about 20,000 persons, more individuals than any other man living, that never any fatal result has followed; in the meantime, it is estimated that upwards of 3000 lives have been lost during the administration of ether and chloroform.

ON THE INFLUENCE OF TEMPERATURE ON THE ELECTRIC CONDUCTING-POWER OF ALLOYS.

By Augustus Matthiessen, F.R.S., Lecturer on Chemistry in St. Mary's Hospital, and Carl Vogt, Ph.D.

(*Concluded from page* 211.)

II. *Experiments on the Influence of Temperature on the Electric Conducting-power of some Alloys composed of three Metals.*

In the course of the previous experiments we were induced to try whether the influence of temperature on the conducting-power of the three metal alloys would be regulated by the foregoing law, and the following tables contain the results:—

Gold-copper-silver alloy, containing 50 volumes per cent. gold, 25 copper, and 25 silver (hard drawn).

Length, 341·5 millims.; diameter, 0·618 millim.

		Reduced to 0°.
Conducting-power found before heating the wire	10·6186 at 13·7°	10·6960
Ditto, after being kept at 100° for 1 day	10·6367 at 6·0	10·6681
Ditto, for 2 days.	10·5855 at 6·7	10·6232

T.	Conducting-power.		Difference.
	Observed.	Calculated.	
10·75°	10·5637	10·5617	+0·0020
33·52	10·4341	10·4346	−0·0005
55·15	10·3130	10·3148	−0·0018
78·35	10·1846	10·1873	−0·0027
97·52	10·0857	10·0828	+0·0029

$$\lambda = 10{\cdot}6220 - 0{\cdot}0056248t + 0{\cdot}0000009863t^2.$$

Gold-copper-silver alloy, containing 40·67 volumes per cent. gold, 39·81 copper, and 19·52 silver (hard drawn).

Length, 582 millims.; diameter, 0·625 millim.

		Reduced to 0°.
Conducting-power found before heating the wire	12·007 at 15·1°	12·109
Ditto, after being kept at 100° for 1 day	11·978 at 15·5	12·088
Ditto, for 2 days	11·915 at 16·5	12·026
Ditto, for 3 days	11·914 at 15·9	12·020

T.	Conducting-power.
9·0°	11·956
54·5	11·647
100·0	11·438

$$\lambda = 12{\cdot}017 - 0{\cdot}0069033t + 0{\cdot}00001111t^2.$$

Gold-copper-silver alloy, containing 3·67 volumes per cent. gold, 83·32 copper, and 13·01 silver (hard drawn).

Length, 764 millims.; diameter, 0·558 millim.

		Reduced to 0°.
Conducting-power found before heating the wire	44·820 at 18·4°	44·272
Ditto, after being kept at 100° for 1 day	42·994 at 17·1	44·348
Ditto, for 2 days	42·983 at 18·2	44·424
Ditto, for 3 days	43·047 at 17·0	44·395

T.	Conducting-power.
11·0°	43·591
55·5	40·300
100·0	37·560

$$\lambda = 44{\cdot}472 - 0{\cdot}081525t + 0{\cdot}0001240t^2.$$

Alloy.	Volumes per cent.	Conducting-power at 100°.		Percentage decrement.	
		Observed.	Calculated.	Observed.	Calculated.
Gold-copper-silver (hard drawn)	50 Au, 25 Cu, 25 Ag	10·14	62·89	5·20	4·72
Ditto	40·67 Au, 39·81 Cu, 19·52 Ag	11·52	64·84	4·82	5·25
Ditto	3·67 Au, 83·32 Cu, 13·01 Ag	37·39	70·09	15·54	15·63
Argentan	12·84 Ni*, 36·57 Zn, 50·59 Cu	7·46	44·44	4·39	4·98

The values in the latter table indicate that the law will probably hold good for most of the three metal alloys.

There is, however, one of the three metal alloys which we cannot pass over unnoticed—namely, that of copper-nickel-zinc or argentan (german silver). This alloy has long been used, on account of the small effect which temperature has on its conducting-power, for making resistance coils, &c. It is a somewhat curious fact that the conducting-power of this commercial alloy decreases less between 0° and 100° than almost any other alloy yet known, for in the course of this investigation we have only found the following, which show a smaller percentage decrement in their conducting-power than argentan.

The conducting-power of the platinum-silver alloy, containing 19·65 volumes per cent. platinum, decreases between 0° and 100° 3·10 per cent.

The conducting-power of the palladium-silver alloy, containing 23·38 volumes per cent. palladium, decreases between 0° and 100° 8·40 per cent.

The conducting-power of the iron-gold alloy, containing 10·96 volumes per cent. iron, decreases between 0° and 100° 3·84 per cent.

The conducting-power of the argentan decreases between 0° and 100° 4·39 per cent.

III. *On a Method by which the Conducting-power of a Pure Metal may be deduced from that of the Impure one.*

This part of our subject is an important deduction from the law

$$\mathrm{Po} : \mathrm{Pc} : : \lambda_{100°} : \lambda'_{100°}; \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

for if we consider the two last terms of the proportion, and bear in mind that a small amount of another metal has very little or no effect on $\lambda'_{100°}$, when it represents the conducting-power of an alloy containing a very small percentage of the one metal, whereas it has a very considerable one on $\lambda_{100°}$, we may write the proportion

$$\mathrm{P} : \mathrm{P}' : : \mathrm{M}_{100°} : \mathrm{M}'_{100°}, \quad . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

where P and P′ represent the observed and calculated percentage decrements in the conducting-power of the impure and pure metals between 0° and 100°, and $\mathrm{M}_{100°}$ and $\mathrm{M}'_{100°}$ their conducting-powers at 100°. P′ is for most metals 29 307, or we may express it as follows:—

The percentage decrement in the conducting-power of an impure metal between 0° C. *and* 100° C. *is to that of the pure one between* 0° C. *and* 100° C. *as the conducting-power of the impure metal at* 100° C. *is to that of the pure one at* 100° C.

From the results given in the tables on page 210, we have chosen the following alloys to show that a small amount of foreign metal has no influence on the value $\lambda'_{100°}$, which may therefore be looked upon as equal to $\mathrm{M}'_{100°}$.

Alloy.	Volumes per cent.	Conducting-power at 100°.		
		Observed.	Calculated.	
Tin-copper (hard drawn) . . .	1·41 of Sn	48·89	69·78	Pure copper conducts at 100° 70·27
Zinc-copper (hard drawn) . .	5·03 of Zn	47·93	68·13	
Gold-copper (hard drawn) . .	1·37 of Cu	43·85	55·33	Pure gold conducts at 100° 55·90
Gold-copper (hard drawn) . .	0·71 of Au	62·25	70·54	Pure copper conducts at 100° 70·27
Platinum-silver (hard drawn)	2·51 of Pt	28·07	69·24	Pure silver conducts at 100° 71·53
Copper-silver (hard drawn) .	1·65 of Ag	65·81	70·66	Pure copper conducts at 100° 70·27

If now, as in the case of most commercial metals, the amount of impurity be much smaller than that in the table, then of course its influence on the value $\lambda'_{100°}$ is so small, that it may be entirely disregarded.

IV. *Miscellaneous and General Remarks.*

Having thus described the results obtained in this investigation, it only remains for us to make a few general remarks on them.

The percentage decrement in the conducting-power of alloys between 0° and 100° is never greater than that of the pure metals composing them; for on looking at the tables on page 210, we only find a few cases where the observed percentage decrement is greater than that of the pure metals composing the alloy, and in these the differences are so small that they are undoubtedly due to small errors in the observations, for the differences between the percentage decrements are not greater than those obtained for different wires of the same metal.

* Values found by analysis. Of this wire all our normal wires were made. According to former experiments (Philosophical Transactions, 1862, p. 5), the formula for the correction of conducting-power for temperature of this alloy was

$$\lambda = 7{\cdot}803 - 0{\cdot}0034619t + 0{\cdot}0000003951t^2.$$

The conducting-power of alloys decreases with an increase of temperature. This, however, is not strictly true for all alloys, for we already know of some where this is not the case—viz., a few of the bismuth alloys.

There must be, therefore, with some of the bismuth alloys some disturbing cause, which may act either in the one direction or the other, for on investigating one series the opposite effect is produced. This disturbing cause may be so great that, as in the case of another, it appears as if the conducting-power increases with an increase of temperature. Other alloys of bismuth and lead, rich in bismuth, give the same results. As yet, we have not had time to investigate thoroughly this curious property of the bismuth alloys; we hope, however, to be able shortly to do so, as well as explain the reason of these remarkable exceptions to the law, that the conducting-power of alloys decreases with an increase of temperature.

Respecting the parts the metals take in the conducting-power of their alloys, we are at present unable to give any definite data; we did hope at one time to have deduced them with the help of the results in this paper. It is scarcely necessary to point out that in many cases the composition of the alloy may be deduced from its conducting-power in the same manner as it may be from its specific gravity; for as

$$\mathrm{Po} : \mathrm{Pc} : : \lambda_{100^\circ} : \lambda'_{100^\circ}, \quad \quad (1)$$

then, if Po and λ_{100° be determined, Pc being known $(=29{\cdot}307)$, λ'_{100° can be calculated, and from it the relative amounts of the component metals for

$$\lambda'_{100^\circ} = \frac{xc + (100 - x)c'}{100},$$

where x represents the volumes per cent. of the one metal, $(100 - x)$ those of the other, and c and c' their conducting-power at 100°.

Thus the observed conducting-power of the gold-silver alloy at 100° is 14·05, and its percentage decrement 6·49,

$$\lambda'_{100^\circ} = \frac{14{\cdot}05 \times 29{\cdot}307}{6{\cdot}49} = 63{\cdot}45,$$

therefore

$$63{\cdot}45 = \frac{71{\cdot}56^{*} x + 55{\cdot}90^{*}(100 - x)}{100},$$

or

$$755 = 15{\cdot}66x,$$
$$48{\cdot}20 = x.$$

The amount of silver in the alloy was 47·92 volumes per cent. Again, the platinum-silver alloy, containing 19·65 volumes per cent. platinum, conducts at 100° 6·49, and loses in conducting-power between 0° and 100° 3·10 per cent.; calculating in the same manner the percentage amount of silver, we find it equal to 82·67 instead of 80·35. The values deduced for the percentage amounts only agree in a few cases well with those found by analysis, as slight errors in the determinations materially affect them; for instance, if the conducting-power of the gold-silver alloy were equal to 14·20 at 100° instead of 14·05, the volumes per cent. of silver deduced from that value would be 52·62 instead of 48·20, the value calculated from the latter number.

It may be as well to state in a few words how we determine to which class a metal belongs, whether to the lead, tin, &c., or to the gold-silver, &c., class; to do this it is only necessary to alloy the metal with traces of lead, tin, &c., and if the conducting-power be equal to that of the mean of the components, we say it belongs to the lead class; if, on the contrary, the alloy has a lower conducting-power than the mean of the components, we say it belongs to the gold-silver, &c., class. These are only some of one series of alloys which have a higher conducting-power than the mean of their components, and these are the amalgams.

In conclusion, we would point out that the law which we have deduced from our experiments only holds good in cases where the alloy may be considered a solution of one metal in the other, the metals belonging to the same class; when the alloy is composed of metals of the two classes, then the law no longer holds good (except for a few of the alloys), even if the alloy be a solution of the one metal in the other. The results which we have obtained and described in this paper fully bear out the views put forward in a former one regarding the chemical nature of the alloys.†

* Observed conducting-power of silver and gold at 100° (Philosophical Transactions, 1862, p. 24).

† Philosophical Transactions, 1860, p. 161.

THE OVERLAND TELEGRAPH TO AMERICA.

Referring to the proposed line of telegraphic communication, promoted by Mr. Collins, and to the action taken by the Government to refuse exclusive privileges to any foreign company, the *Colonist* observes :—

"The late despatch from the Secretary of the Colonies, objecting to the exclusive clause in the Telegraph Bill, will probably delay for a considerable period the completion of our telegraphic communication with San Francisco, and consequently with the East. It is the fault, however, of either the past or present Government that this difficulty has arisen, for the despatch in reference to the Collins line of telegraph, written on the 10th of February, arrived here some time previous to the passage of the Telegraphic Bill. By that despatch it was evident the Home Government would not sanction an exclusive privilege; and it was therefore exceedingly negligent on the part of the Executive at the time that this was not made known to the Legislature before the bill had passed both Houses. The Imperial authorities could not of course sanction an exclusive privilege to any line connecting these colonies with the neighbouring States, for that would have interfered with the Collins line connecting Europe with America by way of the Russian possessions and British Columbia. Mr. Cardwell's objection, therefore, on this head was tenable; but when the Secretary for the Colonies tells us that the strict enforcement of the non-exclusive principle between the British and American territory on the Pacific 'is peculiarly indispensable in British Columbia, through which her Majesty's Government may have to communicate in very critical times and in very important matters with her Majesty's naval forces on the Pacific,' he writes something that is very like nonsense. If the exclusive principle had been granted to a British Columbian line or one confined to British territory, Mr. Cardwell's reasoning would have been profound enough; but as the exclusion was only connected with lines running from British territory west of the Rocky Mountains to American territory similarly situated, the 'peculiarly indispensable' enforcement of the non-exclusive principle is scarcely based on proper grounds. The Home Government desire an overland telegraph through British territory. It is by this line—and this alone—that her Majesty's Government would communicate 'in very critical times with the naval forces on the Pacific;' but Mr. Cardwell must have seen a clause inserted in the Telegraph Bill to the effect that the exclusive principle was in no way to affect this intercolonial and transcontinental line.

"As the thing stands, we must make the best of it. We presume the California Telegraph Company will not recede from their undertaking even under this discouragement; but if they do it will devolve on the mercantile class here to risk the submarine part of the enterprise and connect with the telegraph which will shortly be in running order on Puget Sound. The advantage to Victoria of instantaneous communication with San Francisco as well as with the East is too palpable to require a word of comment, and the sooner the project is carried out the better. There have been too many hitches about the overland line to expect its completion before the expiration of another year. English companies have a cumbrous, unwieldy character about them that makes their progress especially tantalising to the people of a new country. In the summer of 1862 the Duke of Newcastle stated in the House of Lords that he expected by the time the Parliament would assemble in 1863 he would be in the position to inform their lordships that telegraphic communication had been established between Quebec and New Westminster. More than a year and a half has elapsed since the time the late Secretary for the Colonies anticipated would have seen the line in operation, but we seem to be still distant from the summit of our hopes. It is true the new Hudson's Bay Company is making an effort to carry a line of telegraph through; but beyond mere hearsay statements, there is nothing to lead us to believe in any immediate or energetic movement from this side of the Rocky Mountains."

HUGHES' SUBMARINE BATTERIES.

This invention consists in the construction and application of certain machinery, whereby submarine batteries, mines, or charges may be projected from the bows or other parts of a ship, discharged or drawn back into the ship with security, facility, and rapidity. For this purpose an opening is made in the ship at the requisite distance below the water line and inside of the ship, and opposite said opening a cylinder is attached, the length of which is equal to

about three times its diameter, and on the inner end of such cylinder is adapted a moveable water-tight cover, and towards its centre an ordinary sluice valve. The explosive material constituting the battery or mine is charged in a metallic shell, which is attached to the extremity of a rod. To place the battery ready for action, the sluice being let down, the external cover is taken off, the shell placed in the pipe, the cover run over the rod, (through a stuffing box provided for that purpose,) and the said cover is then bolted firmly to the pipe. The sluice being then drawn up, the battery is projected from the ship to the extent allowed by the rod.

The explosion of this battery is effected either by contact on striking any desired object, the shell in such case being provided with the usual means employed for igniting explosive materials by concussion, or it may be made to explode by an electric spark emitted from an electric battery in the ship, and conducted to the explosive materials by wires laid through the rod made hollow for that purpose.

In order to protect the cylinder from the effects of the explosion of the battery, a revolving shutter or escutcheon is hung outside the ship on a pin, and worked by a lever placed within the vessel. In order to give passage to the battery being thrown out or drawn in, it (the shutter) is raised; under all other circumstances it remains closed; besides arresting the force of concussion this shutter serves as a support to the rod in addition to the cylinder head and roller. When it is required to work this battery the rod is passed through the rollers, and the stuffing box in the cylinder head and the battery is united to the rod by means of the union joint, and thrust forward in the cylinder by means of the lever; the cylinder head is then run forward and bolted to the cylinder, the valve drawn up, and the shutter thrown back; the battery is run out by means of the handle to any desired extent within the limits of the rod; the shutter is then descended, and the swivel joint raised to its position, the extremity of the screw being brought in contact with the end of the rod. When it is required to draw in a battery, the shutter is raised, and the rod drawn in by means of the handle until the battery or charge is lodged in the inner half of the cylinder; the valve is then lowered so as to shut off all connection from the sea; the cock or pipe opened to allow the escape of water from such inner part of cylinder; the head can then be removed with safety, and the battery withdrawn. When the battery made use of is to be fired by contact or concussion the exploding material is hermetically enclosed within the case, which latter is provided externally with any of the ordinary appropriate contrivances for igniting gunpowder by percussion; and when the explosion is to be effected at any desired period, and at the command or will of the captain or officer in charge of the battery, an electric battery is used, ignition taking place by means of the passage of an electric spark through the charge produced by appropriate wires laid in the hollow rod.

TELEGRAPHS TO CHINA AND AUSTRALIA.

A PUBLIC discussion between parties holding different opinions on such a subject as the practicability of establishing submarine telegraphic communication between any given points is one of the most searching methods by which we can arrive at the truth. Such a discussion has been going on in the columns of a contemporary with reference to the practicability of laying and maintaining submarine telegraph cables between Rangoon and Singapore, and thence to China and Australia. A correspondent, "C," and two engineers, Sir C. Bright and Mr. Forde, have engaged in this discussion. "C" maintained the impracticability of the undertaking, and the two engineers its perfect practicability. It was agreed between the controversialists that, in order to secure permanent success to submarine telegraphs, it was necessary that the different cables should be capable of being laid in a depth not exceeding 50 to 100 fathoms, in comparatively short sections, and generally over an even bottom. The whole discussion, therefore, turned upon whether all, or, if not all, which of those conditions exist in the seas proposed to be traversed by telegraph cables. We must state that "C," who admitted that at first he had not examined the Admiralty charts, subsequently withdrew many of his allegations, and the points in dispute were in consequence very much narrowed. The whole of the seas in question have been surveyed and sounded, except a distance of some 550 miles between Macassar, in the island of Celebes, and 70 miles to the south of the island of Timor, which lies 400 miles off the northern coast of Australia. The termini of the proposed telegraphs are to be Hong Kong in China, and the head of Gulf Carpentaria in Australia, whence a land telegraph, of about 1,200 miles in length, is to connect the cable with the Australian telegraph system at Brisbane. "C" appears to have been frightened by the great length of the proposed telegraph systems as much as by anything else, and to have been utterly incredulous that it could be carried out in three years, as was asserted by the engineers. To this, however, Sir C. Bright gave a conclusive answer, stating that the Persian Gulf telegraph cable had been manufactured at the rate of 50 miles a week; that at that rate the cable required for the China and Australian lines would be completed in about two years, even if the contracts were not divided among several manufacturers; and that the laying of the different sections would proceed upon the completion of the several lengths, so that the last section could be laid within the time named. As regards the allegation of the great length of the proposed submarine systems, requiring about 6,000 miles of cable, the answer given was that the different lines would be divided into sections of 400 to 500 miles at most, or about the same length as the cable which connects us with Denmark, and the same length as some of the sections of the Malta and Alexandria telegraph. The real dispute, however, turned upon the depth and nature of the bottom in the different seas in question, and for information upon these points the Admiralty charts were referred to. These charts certainly bear out the allegation of the engineers, as was admitted by "C," that between Rangoon, Singapore, and Hong Kong a telegraph cable can be laid in a depth not exceeding 50 fathoms, which will admit of its being raised for repairs without difficulty. "C," however, insisted upon the existence of coral, and its injurious effect upon the cable; the engineers assert that, though coral exists, the cable can everywhere be laid clear of it between the reefs, and that, except in very shallow water, and where very strong currents exist, coral does not seriously injure a cable.

So much for the line to China. As regards the line to Australia, the charts show that between Singapore and Batavia the depth of the sea does not exceed 23 fathoms, and is frequently not more than 12 fathoms, which is admitted to be too shallow, though the depth of this sea is not less than that of the North Sea, where the cables connecting us with the Continent are laid. As regards the sea between the east end of Java and the head of Gulf Carpentaria, the depth, with the exception of the 550 miles which have never been sounded, varies from 40 to 80 fathoms. It is with respect to these 550 miles of sea which have not been sounded that conjecture is rife. "C" appears to be of opinion that, with the exception of 70 miles to the South of Timor, the remainder of the unsounded portion of the sea is shallow, and the engineers state that even if the 70 miles which are excepted prove to be deep, the loss in case of rupture in the cable at that point will be trifling.

As regards the practicability of the proposed telegraph, we have endeavoured to place the case as fairly and clearly before our readers as the arguments of the disputants and the evidence afforded by the charts enable us to do. It is evident that in this case we have to deal with shallow seas and short sections—two most important elements, the former especially, in the permanent success of submarine telegraphy. The Malta and Alexandria telegraph, of a length of 1,330 miles, has now worked for over three years with an average interruption of forty-five days per annum, the greater portion of which the engineer attributes to the absence of a steamer at Malta fitted up with the appliances to repair the cable when ruptured. We may, therefore, reasonably hope soon to see carried out the China and Australian lines, especially as long telegraph lines are now proved to be very remunerative, the Malta and Alexandria line having paid 17 per cent. to the Government and the lessees whilst in working order. Moreover, the Dutch and the Australian Governments have in every way encouraged the proposed lines. It is, however, a great point that their practicability has been established, and it is to this question alone that our observations have been directed.—*Money Market Review.*

POVERTY A RELATIVE TERM.—Bulwer says that poverty is only an idea, in nine cases out of ten. Some men with ten thousand pounds a year suffer more for want of means than others with three hundred. The reason is, the richer man has artificial wants. His income is ten thousand, and he suffers enough from being dunned for unpaid debts to kill a sensitive man. A man who earns five shillings a day, and does not run in debt, is the happiest of the two. Very few people who have never been rich will believe this, but it is as true as God's word. There are thousands and thousands with princely incomes who never know a moment's peace because they live above their means. There is really more happiness in the world among working people than among those who are called rich.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XIV.

A.D. 1838, April 18.—No. 7614.—Cooke, William Fothergill.—"Improvements in giving signals and sounding alarums at distant places by means of electric currents transmitted through metallic circuits." This invention may be divided into the following parts:—

Part A.—An intermediate signal apparatus that can transmit signals to either terminus as well as receive signals, being an improvement on the 5th particular of No. 7390. At the intermediate station, finger keys and a galvanic battery are connected to the intermediate apparatus, and thence suitably to the line wires, in order to communicate to stations in one direction or the other by means of a "current director," adjusted by an "index" or button on the outside of the signal apparatus. The current director consists of a wooden lever, to which wires from the keyboard are attached at the side, being insulated from each other; according as the current director is moved up or down from an intermediate position, it makes communication with fixed insulated springs, in connection with the line wires, to stations in one direction or the other, thus placing the finger keys in the circuit. When the current director is in an intermediate position (*i.e.* not in contact with either set or fixed springs), the line wire circuit is completed only through the needle coils, and signals can be received, as the communicating springs are not then pressed apart by the current director. The tail of the current director, by means of springs in a similar way, introduces the battery of the intermediate station. The signal instrument, described in connection with this part of the invention, has four needles and five line wires.

Part B.—Connecting the alarum apparatus of an intermediate station, during the time it is transmitting messages, so as to receive audible signals from stations in an opposite direction to that receiving signals from it. The current director carries a flat plate or "cross piece," at the opposite side to those connected with the keyboard, that makes connection with the opposite line wire circuit to that engaged in transmitting messages, and its return wire. The index also carries a wooden prominence, that at the same time makes contact with springs in the line wire circuit and the alarum apparatus, the wooden prominence for that purpose carrying insulated metal pieces in connection with the alarum circuit.

Part C.—Temporarily connecting a portable apparatus with the line wires to give and receive signals. At certain portions of the telegraph line the wires are carried up into boxes, and are fitted with connecting pieces that can be removed, in order to include in the circuit a battery and signal instrument when required. In connecting a portable apparatus, a block of wood, with insulated springs carrying the junction wires, is locked into the box by a cross bar passing into the notched groove used to lock its door. The signal apparatus described is only a double instrument having three line wires, and is connected up or down the line by a current director, turning half round on an axis, but on the same principles as that described in Part A. The keys described in connection with this instrument consist of small levers or finger tappets, each poised on a distinct centre pin of its own, and arranged so that the depression of the key corresponds to the deflection of the needle; this key is the same in principle as that described in No. 7390, but the application is different. Contact with the cross bar (or the continuity of the line wire) is broken by the flexure of a watch spring on the lever arm.

Part D.—Securing and protecting telegraph wires, by laying them in, or drawing them into, tubes or pipes, as gas pipes, soldered together, or screwed together with screw joints or union joints.

Part E.—Using magnetic attraction, with or without the aid of gravitation, to steady telegraph needles.

Part F.—Sounding alarums without the assistance of a local battery. The fly of a clockwork actuating the hammer is released by the deflection of a magnetic needle acting on a delicately poised lever, which has an arm that cannot resume its position until a stop on the lever is allowed to enter a notch in a slow moving wheel. The telegraph needles may be used for this purpose.

A.D. 1838, July 4.—No. 7719.—Davy, Edward.—"Improvements in apparatus for making telegraphic communications or signals by means of electric currents, parts of such apparatus being applicable to obtaining, regulating, or measuring electric currents for other purposes," consisting of:—A chemically marking telegraph. A local circuit (completed by galvanometer needles acted on by the line circuit) marks chemically prepared paper, which is moved forward by clockwork released by an electro-magnet. Two line wires are used to convey the electric current, and one return wire, with a battery and two galvanometers (deflecting opposite ways) to each wire; the battery to the return wire giving a preponderance to currents through that wire, twelve different signals can thus be produced. The action is as follows:—On one or more of six keys being pressed down, either two or three of the galvanometers act; and as the three wires admit of the current proceeding in either direction through them, it can complete either two or three out of the six circuits of the local battery; thus marking longitudinally properly prepared paper at two or three out of six places. The clock-work escapement, for moving the paper a sufficient distance between the signals, consists of two levers, one of which carries the armature, and works on a horizontal axis carried by the other lever. When the armature is attracted, it releases a pin from a notched fly vane, and enables it to move half a revolution; and when the current ceases, the pin is again removed, and replaced by lateral motion given to the second lever by a wheel pressing against a projection on it. Calico, "impregnated with hydriodate of potash and muriate of lime," is preferably used to receive the marks or signals. "Relays of metallic circuits," transmitting the electric current throughout, in the desired direction, brought into operation by means of galvanometer needles as in the above-described telegraph. An arrangement enabling the person communicating to send the communication to any desired place. Branch wires are laid to each place, and the circuit is completed to the desired place by the assistance of electro-magnets acting on a lever or levers according to the direction of the current. These magnets are charged by a local circuit, completed by galvanometers, as above. An improved galvanometer, in which the magnetic needle is mounted on a horizontal axis; the strength of an electric current is ascertained by the weight it will overcome in a scale attached to the needle, or by a sliding weight.

A.D. 1838, July 11.—No. 7729.—Callet, Louis Cyprien (*a communication*).—The title of this invention is, "Certain improvements in machinery or apparatus for producing motive power, applicable to propelling boats and other vessels, carriages, machines, and other useful purposes." This invention relates to motion obtained by means of soft iron or steel cores or "bolts," moving reciprocally within electro-magnetic "helices." This invention consists of a "bolt" or bolts attached to the extremities of a beam, similar to that of a Boulton and Watt's steam engine, and working into helices in a similar manner to that of the piston and cylinder of the steam engine, the helices being fixed to the foundation plate of the machine. Motion of the "bolts" at each extremity of the beam is produced by the galvanic current being admitted alternately to the helices at the opposite extremities of the beam; this is accomplished by means of "straps," or "thin slips or bars of copper, tin, or silver," pressing upon a "wooden cylinder or wheel" on the crank shaft, having two "pieces of silver" inserted in the wood which complete the electric circuit with each helix or set of helices alternately, and thus produce motion.

A.D. 1838, July 18.—No. 7737.—Hoe, Richard March (*a communication from Dr. H. H. Sherwood*).—This invention relates to an instrument containing a "dipping needle," with graduated vertical and horizontal arcs and tables, by which "the latitude or longitude of any place on land, or of a ship at sea, may be ascertained and determined without the aid of celestial observations, and also the dip or inclination and variation of the magnetic needle ascertained." The instrument is called, "Sherwood's magnetic geometer." The inventor states that he has constructed the above-mentioned tables from the latitude and longitude of the northern and southern magnetic poles, their rate of motion, and the position of the line of no variation at a given time, as determined by himself. Two instruments are described and shown: one, in which the dipping needle is a "rhombus," mounted upon agate centres within a vertical arc having spirit levels; it also has a horizontal arc and moveable nonius, and several moveable concentric circles of figures, so arranged as to bring the different figures required in calculation one above the other. Another, in which a "magnetized ring" is used, carrying two verniers and supported on agates; "two forked pieces of brass," that can be raised or depressed by moving a slide, place the axis of the magnet at right angles to the vertical divided circle. For observations at sea the instrument must be "suspended by universal joints," or "a liquid bath." The moveable concentric circles of figures consist of 9 circles nearest the centre of the

instrument, containing "a table of one-half the diurnal variation in every latitude;" next to these, 6 circles, containing a table of "the declination of the needle from nothing to its maximum of 23° 28′ at the terrestrial equator;" and externally, next to the nonius circle, 6 other circles giving "the declinaton of the magnetic axis, or line of no variation, in which "the declination of the needle from nothing to 90° is converted into degrees of longitude." Copious examples are given of the obtainment of the variation of the needle, and latitude and longitude of places, from the instrument and table, but there is no special explanation of the precise method of working them.

A.D. 1838, July 24.—No. 7742.—Elkington, George Richards, and Barratt, Oglethorpe Wakelin.—"Improvements in covering and coating certain metals," in which improvements electric force is used. To coat copper and brass with zinc, "to prevent oxydation:"—"Zinc in the state of powder or pieces" is added to dilute muriatic acid, and allowed to remain "until the acid and zinc cease to act upon each other;" this solution is then poured off and boiled with comminuted zinc, during which time the articles to be coated are immersed in the solution, and brought into "contact with the metallic zinc," when they speedily become coated, and are then removed, washed, and dried. To coat iron and steel with the above solution:—The articles are previously coated with copper, by cleansing them in dilute sulphuric acid, and immersing them in a solution of sulphate or nitrate of copper, whence they are speedily removed and washed; or they may be at once immersed in the muriatic acid solution in contact with the excess of zinc, removed, washed, and dried. In either of the above processes the copper surface may be "introduced into a dilute solution of nitrate of mercury, and then again boiled in the solution of zinc," by which the same object is obtained. "Iron, steel, copper, brass, &c.," are coated with an "amalgam of zinc" "to prevent oxydation," by immersion in contact with the amalgam to which dilute acid has been added. Muriate or sulphate of ammonia, or the oxides of the metals, may be employed instead of muriatic acid, or other acids may be used; or the amalgam of zinc may be employed "in a melted state." Coating by fusion may be employed in conjunction with the above processes. Iron or steel is coloured to imitate brass, by coppering and zincing it as above described, and submitting it to heat in a closed oven until the required colour is obtained, as in "semiloring" copper and brass. [Although no mention is made of electricity in the specification, the immersion of the metal in the solution of zinc in contact with zinc or amalgam of zinc, forms a galvanic circuit, and thus employs electric force.]

A.D. 1839, June 8.—No. 8096.—De Bode, Baron Henry.—"Improvements in the means of rendering magnetic needles less prejudicially influenced by local attraction, which improvements are applicable to other magnetic objects for the same purposes." A mariners' compass is described and shown, in which the needle and card are supported by a pivot cemented to "a double glass vessel," containing "quicksilver," so as to get "a metallic surface of quicksilver within two surfaces of glass between the magnetic needle and the local quantity of iron." This glass vessel "is placed within an outer vessel of lead, consisting of two thicknesses of lead, which is a metal little affected by the attractions or fluids which influence the magnetic needle, and there is, by preference, a thickness of glass between the double lead vessel." "The compound vessel containing the compass is suspended on the ordinary gimbles" by means of "a brass strap." A concave glass forms a "corner" [cover?] to the vessel, thus allowing "more play to the card," but preventing "its being thrown off the point." A chronometer may be placed in such a vessel, to prevent "the errors which have been found to be produced by magnetic influences."

A.D. 1839, August 26.—No, 8207.—Pinkus, Henry.—Methods of applying and using the power derived from the pressure of the atmosphere, by means of a partial vacuum called the "pneumatic atmospheric auxiliary power," and the impelling force to be derived from "explosive mixtures" (carburetted hydrogen gas in union with air) called the "gaso-pneumatic power." The specification and drawings describe and show, at great length, the following particulars:—A method of applying the above motive powers to the various operations of agriculture, by means of "hermetically sealed mains or pipes" laid down in the fields, which, in the first case, are exhausted of air by a stationary engine, and, in the second case, conduct gas from the stations to the various parts in which the power may be required. A locomotive "atmospheric impelling engine," and a locomotive "gaso-pneumatic engine" connected to the mains by flexible tubes. Various agricultural implements connected with the "impelling engine," ploughshares attached to levers, harrows, scythes, and spades. In the application of the invention to railways, canals, and common roads, "close tubes" are laid down, which are connected at certain distances with "valve mains," having longitudinal valves formed by metal valve plates pressing together, and placed angularly on the main over a longitudinal aperture, so as to admit a "flat pipe or tongue" between them from the locomotive. A valve may be made by having one valve plate of leather strengthened with copper plates, whose upper edge lays in a groove in a "raised vertical surface;" the groove contains an insulated copper wire, which is included in a galvanic circuit by a "conductor" projecting from the locomotive, thus melting cocoa-nut oil in the groove, as the train passes, "in advance of the locomotive;" the galvanic batteries may either be on the locomotive or at stations along the line, in which case a wire is laid parallel to the gas valve main; this last valve may extend the whole length of the railway. "The pneumatic principle may be applied" to agricultural purposes by means of "a plenum instead of a partial vacuum."

A.D. 1839, October 24.—No. 8248—Graydon, George.—The title of this invention is, "Certain improvements in instruments for which Letters Patent were formerly granted to me, and which were called therein, 'A new compass for navigation and other purposes,' part of which improvements are applicable to instruments for measuring angles at sea or on shore by aid of reflection or refraction, or of reflection combined with refraction, and part are applicable to magnetic compasses for ascertaining true bearings from celestial observations, and for comparing the same with the bearings of the magnetic needle contained in such compasses, whereby to determine and be enabled to allow for the deviation of such needle from the true meridian, whether by variation, local attraction, or other cause of error;" but it only refers to magnetic compass needles and cards as a part of the "celestial compass" alluded to in this specification. For the former invention alluded to, see Letters Patent, No. 4996. "The compass bowl," "carrying the measuring circles of the celestial compass," has a pendulous weight, and is suspended on "a series of gimbal rings" (three are shown in the drawings), with weights attached to them, so as to act as pendulums of different lengths, and thereby prevent the motions of one from being communicated to the others, and keep the instrument horizontal. In another modification of the invention, the weighted compass bowl is mounted on the vertex of a weighted cone, which is on the vertex of another weighted cone, on a central pivot; the weights being so disposed as to act as in the gimbal compass first described. A method of ascertaining the variation of the magnetic needle by this instrument is set forth. "An instrument for measuring angles by reflection, after the mode of Hadley's sextant, but instead of referring those angles to the visible horizon of the sea by directing the telescope," "or line of sight to view that horizon, the same is directed to view the pole star," is also described and shown.

A.D. 1839, November 2—No. 8255.—Taylor, William Hannis.—"Improvements in obtaining power by means of electro-magnetism." The specification and drawings describe and show rotary engines, in which either the "armatures" are fixed, and the electro-magnets revolve, or *vice versâ*, these being arranged in the circumference of a circle, so that the magnets or "armatures" (as the case may be) may freely move near to the "armatures" or magnets opposite to them. The magnets are demagnetised when opposite each armature, and until within the attractive influence of the next armature, thus producing a continuous rotary motion. A conducting disc, inlaid with non-conducting material, and in connection with one pole of the galvanic battery, magnetises and demagnetises the electro-magnets at the proper times; and by arranging the conductor in connection with the disc communicating with the electro-magnets, and thence with the other pole of the battery, in different relative positions, the engine may either move in a forward direction, be stopped, or reversed. No change of magnetic polarity takes place in this engine.

TELEGRAPHY AND PHRENOLOGY.—In these days of rapid transmission of news, young men often apply to us (Editors of *American Phrenological Journal*) to know what organs of the brain are most necessary to a telegraph operator. In reply to this, we say in general, all the intellectual faculties well developed and active, are very desirable for this as for any other intellectual pursuit; but the telegraph operator needs large perceptive organs, especially Individuality, Order, and Time; and if Time be well developed, so much the better, as this gives a ready discrimination of sounds, aiding him to read by the "click" of the instrument. Of course the temperament should be favourable to patient attention and studious habits

MEETING OF THE BRITISH ASSOCIATION AT BATH.

The valuable experiments made by Mr. Glaisher, under the direction of the Scientific Balloon Committee, reveal a number of interesting facts concerning atmospheric electricity and magnetism. In the report of this committee, read by Colonel Sykes, M.P., supplemented by a very interesting narrative of aerial experiments by Mr. Glaisher, our readers will find a considerable amount of useful information. It is not in our power to publish the documents in their entirety, but the following abstracts will be found to contain the pith of the papers:—

Colonel Sykes, M.P., said, the Balloon Committee have sanctioned the following ascents, nine in number, since the appointment of the committee at Newcastle, August 31, 1863, viz.:—from Newcastle, September 29th, 1863; from Wolverhampton, October 9th, 1863; from the Crystal Palace, near London, January 12th, 1864; from Woolwich, April 6th, 1864; from Woolwich, June 13th, 1864; from the Crystal Palace, June 20th, 1864; from Derby, June 27th, 1864; from the Crystal Palace, August 28th, 1864. It is the desire of the committee that winter ascents should be made in the months in which heretofore they had not hitherto been able to effect them; and now, except in three months, they had the results of ascents made in all the months of the year. Owing to the destruction of Mr. Coxwell's great balloon, at Leicester, four of the above only were high ascents. In the other ascents, Mr. Glaisher obtained a seat in the car of the balloon, and space for room of the important instruments, at a cost of £5 for each ascent. These ascents were made by Mr. Coxwell on public occasions, and to a moderate height only, varying from one to three miles. Mr. Glaisher, with unabated zeal and fearlessness, made the ascents, and the necessary observations, the details of which accompany this report. The committee was instructed to "examine the electrical condition of the atmosphere at different heights, and to verify the law of decrease of temperature obtained by Mr. Glaisher, and to compare the contents obtained in different states of the atmosphere." Mr. Glaisher will explain the difficulties in carrying out the first instructions, and the necessity for renewed attempts to verify the electrical condition of the atmosphere. The second instruction has been fully carried out. Owing to the high ascent, ordered to take place at Wolverhampton, in July, 1863, and for which gas was prepared and observed, but which was protracted by continued bad weather, and only taking place on the 29th September, the account of the expenditure from the grant of 1862-3, could not be submitted at the meeting at Newcastle. The account has now been transmitted to the treasurer, with the necessary vouchers, and the disbursements amounted to £199 19s. 9d., out of the £200 granted. The account, with the disbursements, from the grant of 1864, cannot be submitted at the present meeting, owing to some outstanding bills which have not yet come to hand. The electrical and magnetic conditions of the atmosphere at high elevations being incomplete, and an important question with respect to atmospheric refraction having arisen, the committee recommend that further researches be made into these subjects, that the committee be re-appointed, and that £150 be placed at the disposal of the committee. The gallant colonel added, that he could not conclude this report without calling upon the Association generally to express its gratitude to Mr. Glaisher for his perseverance and zeal in carrying out these experiments at great expense to himself, for although the Association defrayed the cost of the actual ascents, the hotel expenses, and other similar charges, he had to defray out of his own pocket.

Mr. Glaisher, who was received with considerable cheering, read the following paper:—The Committee of the balloon experiments was appointed last year to examine the electrical condition of the air at different heights—to verify the law of the decrease of temperature, and to compare the constants in different states of the atmosphere. As to the first object, no progress was made in the beginning of the year, except preparing an instrument for the investigation, under the superintendence of Mr. Fleeming Jenkin, but as no flame or fire of any kind can be admitted in the car of the balloon, for fear of igniting the gas, the instrument could not be used, it has been altered to be employed with water, but is not yet in a fit state for observation. It happens unfortunately that electrical instruments necessitate the use of a constant flow of water, and occasionally of two streams at the same time just below the car of the balloon. The committee felt the presence of such water near the instruments might exercise considerable influence on the instruments, by moistening the atmosphere, and thus throw considerable doubt on some of the experiments, particularly on those as to the humidity of the atmosphere—a primary object of research. With respect to the second object, viz., verifying the law of the decrease of temperature in different states of the atmosphere—it is desirable to obtain as many observations as possible at times in the day and year, at which the experiments had not previously been made, to determine whether the laws would hold good at one time in the year, and at others. The committee at all times pressed on me the importance of magnetic observations in the higher regions; the Astronomer-Royal suggesting the use of a horizontal magnet, and taking the time of its vibration at different elevations, a method seldom practical, as the balloon is almost always in a state of revolution. Dr. Lloyd suggested the use of a dipping needle, placed horizontally when on the ground, by means of a magnet alone, and so that when in the balloon the deviation from horizontality might be noticed, which deviation would be independent of the revolving motion of the balloon. This I have been unable to attempt at present. I readily assented to the wish of the committee, as expressed at Newcastle, that I should not ascend more than four or five miles, as I had found that all observations above five miles would be inferred from those below five miles. And, moreover, the balloon, after so many rough descents, had become, in Mr. Coxwell's opinion, too unsafe for extreme high ascents, I have, therefore, no report to give of any extreme high elevation attained during the past year, yet new facts and new physical conditions have become known in some of the nine ascents upon which I have to speak. Mr. Glaisher then gave accounts of his nine ascents. After the ascent of the 29th September, Mr. Coxwell condemned the balloon as unsafe, and determined to build another, capable of containing 10,000 cubic feet more than the old one, to carry two observers the height of five miles. This needed trying in low ascents, till it proved perfectly gas-tight, there always being a leakage through the new material, and, after several trial trips, it was made and rendered gas-tight, and was destroyed at Leicester. One would scarcely believe it possible that such an act could take place in the centre of England in the present day, but it was so destroyed as to put a stop to all pre-arranged experiments. The Mayor of Leicester has recently presided over a meeting for the purpose of raising a subscription to assist Mr. Coxwell to rebuild a new balloon, which I hope will help to remove the stigma now resting upon Leicester (cheers). I trust the Foresters will also help to remove the stain now resting upon them; for if the act was not that of the Foresters, it was at one of their gatherings, under their superintendence, and the destruction of the balloon by force, I can learn, was not attempted to be stopped by them. He then described the ascent from the Crystal Palace. Having alluded to his observations as to the lines in the solar spectrum, he proceeded to say it was very clear, from the particulars of each ascent, that they cannot all be combined for deducing general laws. Those ascents, which have been made during the past year, under similar circumstances, to those from which the law of decrease of temperature were found when combined, do not change the values previously priced to any great amount, but those which have been made under other circumstances, such as in that in the winter, and at times of the setting sun, differ very greatly indeed. The deviation of this law, however, in winter, is certainly of the highest importance to us. The meeting with a strong current of air S.W., is as great in thickness as nearly a mile, sweeping over our country in the season of winter, and which, one current I know, continued many days, may be the cause of the much higher temperature we enjoy than that due to our position on the earth's surface. This high temperature has been attributed to the Gulf stream, but this washes the coast of France as it surrounds our own coasts, and yet France does not enjoy to the same degree our warm winters. Norway, likewise, enjoys with us a similar warm winter; and it would seem from the observations in January that very much of the comfort of our winters is owing to the south-west wind passing uninterruptedly over the sea to us. These views were published by Dr. Black, of Edinburgh, and seem to be confirmed by the warmth met with in the north-west current I passed through. I have taken meteorological observations since, in fact, the year 1829, and for twenty years I have received at the end of every month the observations made over the whole of this country from forty to fifty years. These he had reduced and discussed, and laid the results down in curves, so that they may be seen; yet I am unable to tell the weather a week hence. I have made and discussed more observations than any other observer, and all I can do is to speak generally of the probable state of the weather for one or two days in advance. Owing to its insular situation, and its variation of climate, this is not the best country for taking observations; and I am glad to learn that similar observations are about to be made in France, and I trust they will be made in those countries where the weather is more uniform, and the observer can be at ease for hours out of sight of the earth. In France, Messrs. Bixio and Barrac made a scientific ascent in July, 1850, from Paris, and passed through a cloud composed of oxides which sustained themselves in the air, as it appeared to them, contrary to the laws of gravity, and upon their horizontal surfaces there was beneath the horizon an exact image of the sun, formed by the reflection of the luminous rays on the crystal: the temperature of the cloud was minus 40°. Many ascents must, therefore, be made before any general laws can be laid down. I think the law of decrease of temperature, under ordinary circumstances, both with a cloudy sky and a clear sky, show the snow is above the horizon in summer and adjacent months. I think it is pretty well determined, but from the only series of observations made in winter, we cannot say such laws hold good throughout the year, nor can we say the same laws will hold good day and night. When I undertook to make these experiments, I expected that a few ascents would have been all that would have been required of me. I have made no less than twenty-two, and so far from exhausting the subject, they indicate a much wider field for future operations. In carrying out these experiments, and the work connected with them, I have given up all my leisure time freely; Mr. Coxwell has done the same, in the most unselfish manner—indeed, I may say, that had it not been for him, the generous spirit in which he has entered into these experiments, they never could have been made, except at a multiple of their present cost. Mr. Glaisher was cheered frequently during his address, which he illustrated by diagrams. Mr. Glaisher resumed his seat amidst enthusiastic applause.

Mr. President was sure that he might, on behalf of the Section, thank Mr. Glaisher most cordially for the very interesting account he had given, and express their hope that he might go on making the series of ascents which were necessary to complete his unexampled and most valuable

experiments and investigations, with the same success and pleasure to himself as had attended his previous experiments.

Mr. Fleeming Jenkin observed that, as Mr. Glaisher had been kind enough to mention his name, in terms far more complimentary than he deserved, as to the assistance he had been enabled to render in carrying out these electrical experiments, he desired only to say that he was ready, at any expense of time and trouble, to aid, so far as he could, in completing those experiments. Mr. Glaisher had referred to the danger incurred in the use of the existing instruments. As those instruments were now arranged, he believed they were safe, provided no mistakes were made in using them, in the same way that guns were safe, if used with proper care, and no mistakes were made by those into whose hands they fell; but in all electrical experiments made in the higher regions, where electrical disturbance was always going on, and especially in the presence of so large a volume of gas, he found there must always be more danger. He was quite satisfied that Mr. Glaisher would not on that account be deterred from continuing his observations. He was happy to add that he, Mr. Jenkin, was to have the aid of Mr. Varley in the attempt to determine what the conditions were that should reduce that danger to a reminiscence.

DAVY AND THE NITROUS OXIDE.

The dangers which enthusiastic men of science will voluntarily undergo for the sake of testing new principles have never been more strikingly exemplified than in the history of Sir Humphrey Davy's early experiments on the effect of nitrous oxide, popularly known as "laughing gas." Davy began his chemical studies in March, 1798, when a youth of eighteen, and only two years later appeared his "Researches," which immediately gave him high rank, not as a mere chemist, but as an original discoverer. Herein, for the first time, the properties of nitrous oxide, and the wonderful effects of that gas in respiration, were disclosed to the astonishment of the public. Hitherto it had been regarded among natural philosophers with a sort of vague horror, and from its deadly effects upon small animals it was suspected that it was the very principles of the plague itself—that terrible visitation which, from time to time, swept over Europe. Nothing daunted by this, the young philosopher boldly resolved to try its effects upon his own system. He could not have been ignorant of the terrors of Spallanzani's experiments upon the gastric juice, and only a short time before the brave Pelletier, the French chemist, had lost his life in the attempt to breathe another kind of poisonous gas. But the boy philosopher thought it necessary to compare the effects of nitrous oxide with those of common stimulants, and he was resolved to pluck knowledge out of this dangerous trial. With this view he shut himself up, and first submitted himself to intoxication so extreme as to produce distressing and even alarming symptoms. To ascertain the effects of an atmosphere containing large quantities of the same gas, he enclosed himself in a box, and at three successive intervals, for an hour and a quarter (during which time he remained in the box), and sixty quarts of the gas thrown in, finally constituting a large proportion of the air which he was breathing. When the last twenty quarts were thrown in, his emotions became similar to those produced by a moderate dose of the pure gas; but, not satisfied with this, immediately after coming out of his cage, he began to breathe in twenty quarts of nitrous oxide, probably the most effectual trial ever made of this wonderful agent.

In his own account of this audacious experiment, Davy observes:—"A thrilling, extending from the chest to the extremities, was almost immediately produced. I felt a sense of tangible extension highly pleasurable in every limb; my visible impressions were dazzling and apparently magnified; I heard distinctly every sound in the room, and was perfetly aware of my situation. By degrees, as the pleasurable sensation increased, I lost all connection with external things; trains of vivid, visible images rapidly passed through my mind, and were connected with words in such a manner as to produce perceptions perfectly novel. I existed in a world of newly connected and newly modified ideas. I theorized; I imagined that I made discoveries. When I was awakened from this semi-delirious trance by Dr. Kinglake, who took the bag from my mouth, indignation and pride were the first feelings produced by the sight of the persons about me. My emotions were enthusiastic and sublime, and for a minute I walked round the room, perfectly regardless of what was said to me. As I recovered my former state of mind, I felt an inclination to communicate the discoveries I had made during the experiment. I endeavoured to recall the ideas; they were feeble and indistinct. One collection of terms, however, presented itself, and with the most intense belief and prophetic manner I exclaimed to Dr. Kinglake, 'Nothing exists but thoughts!—the universe is composed of impressions, ideas, pleasures, and pains.'"

The impunity with which Davy had passed through these wonderful trials emboldened him to attempt the breathing of the deadly fumes from charcoal. His first attempt was made upon four quarts of carburetted hydrogen gas, of which he made three inspirations. "The first inspiration" (he tells us) "produced a sort of numbness and loss of feeling in the chest and about the pectoral muscles. After the second inspiration I lost all power of perceiving external things, and had no distinct sensation except a terrible oppression on the chest. During the third inspiration this feeling disappeared; I seemed sinking into annihilation, and had just power enough to drop the mouthpiece from my unclosed lips. A short interval must have passed during which I respired common air before the objects about me were distinguishable." On recollecting himself he faintly articulated, "I do not think I shall die." Putting one finger on his wrist, he found his pulse thread-like, and beating with excessive quickness. Extreme giddiness, loss of memory, and numbness, succeeded, with excruciating pains in the forehead and between the eyes, and transient pains in the chest and extremities.

Davy was, as far as his philosophical learning went, entirely self-instructed. He was born at Penzance, in Cornwall, on the 17th of December, 1778. Though some attempt has been made to conceal the fact, there is no doubt that his father, Robert Davy, followed the humble occupation of a wood-carver. Robert was known in that town as "little carver Davy," and his son (Humphrey), when young, was always spoken of there as "carver Davy's boy." His father dying when the lad was only sixteen, his mother commenced the business of a milliner, and apprenticed her child to an apothecary at Penzance, where, for the first time, he began to show an interest in his favourite study.

"His means, of course," says his brother, Dr. Davy, "were very limited; not more extensive than those with which Priestly and Scheele begun their labours in the same fruitful field. His apparatus consisted chiefly of phials, wine-glasses, teacups, tobacco-pipes, and earthen crucibles, and his materials were generally the mineral acids and the alkalies, and some other articles which are in common use in medicine." He began his experimental trials in his bed-room, in a friend's house, in which he was a favourite inmate. Here there was no fire, and when he required it he was obliged to come down to the kitchen with his crucible. His biographer, Dr. Paris, states that Davy was indebted to the accident of a wreck on the coast for a case of surgical instruments. This included a clumsy clyster apparatus, which he turned into an air-pump. The sacred vessels and professional instruments of the surgery were, without the least hesitation, put into requisition for any chemical experiments.

It can hardly be doubted that Sir Humphrey Davy's constitution, which was so vigorous in youth, withered and decayed long before he had reached old age from the effects of injuries sustained by these early experiments. He died in 1829, at Geneva, of an attack of apoplexy, but his end was singularly peaceful. When his brother (Dr. Davy) entered the room, Sir Humphrey said: "I am dying! When it is all over, I desire that no disturbance of any kind may be made in the house. Lock the door, and let every one retire quietly to his apartment." The mortal remains of the wood-carver's son—the great philosopher and discoverer—were honoured with a public funeral, and deposited in the cemetery outside of the walls of Geneva.—*American Artizan.*

TELEGRAPHIC NEWS.

Collision at Sea.—The Dix Décembre, Commander Chevalier, French Government telegraph steamship, in the Gulf of Lyons, on Tuesday, the 18th ult., came into collision with the Sea-dog, a new schooner, 123 tons register, from Marseilles. The Sea-dog was sunk, and the captain (Mr. Peters), the boatswain (Thomas Martin), and a sailor (name unknown), were drowned. The captain of the Dix Décembre perceived the Sea-dog approaching, and endeavoured to put his ship about; but the movement was too late, and the Sea-dog was stricken amidships and cut in half. Four of the crew were saved.

Stefani's Telegraph.—The *Malta Observer* of the 20th ult., says:—"Some surprise is expressed, and with an appearance of reason, at the non-receipt of a telegram from Stefani since the 5th inst. We think that this delay may be accounted for by the fact that no event of great political importance has passed on the European Continent within the last fortnight, and that Stefani is allowed to exercise a certain discretion in the transmission of telegrams. In a week there may be occasion to forward several telegrams." This line of communication has long been remunerative to its proprietor; we hope that the manner in which our contemporary accounts for the non-receipt of telegrams may prove accurate.

Cape Clear Telegraph Station.—The *Cork Reporter* states that this station, which has been open a little over twelve months, is, for the present, closed, as far as intercepting American steamers is concerned, the South-Western of Ireland, at Crookhaven, and the Magnetic offices having amalgamated. The Cape will, however, be kept open for meteorological purposes, and will, in all probability, be open again in a few months for the intercepting of steamers. The Flying Childers left for Cork on Tuesday, and is to be transferred to Roche's Point, where the Magnetic Company are about to establish a new station. It is now to be hoped that Skibbereen will be connected with Crookhaven forthwith. The expenses of so doing will be little or nothing, as the wires already, we may say, pass through the town. The advantages of connecting these two places by instantaneous communication are various and quite apparent. Skibbereen, the Queen City of the West, supplies Crookhaven with almost all the necessaries of life; the custom-house, with which Crookhaven must of necessity transact considerable business, is situated in this town, and frequently captains of vessels have to travel a distance of thirty miles, which in many instances could be avoided, were the two places connected by telegraph. This want has long existed, and much disappointment was felt on the opening of the Crookhaven line at the non-establishmet of an office here. Therefore it is that we hope provision has now been made for establishing communication throughout the entire line.

Electric Telegraph Company.—Damaging the Telegraph.—Charles Jones, Frederic Morton, and William Graham, were convicted at Bicester on the 16th of September, 1864, of having, on the 22nd August last, broken one of the insulators of the telegraph line by pelting at it with stones. Jones was sentenced to six weeks' imprisonment; Morton to a fine of £1 or fourteen days' imprisonment; and Graham to a fine of 10s. or seven days' imprisonment. Similar cases of wilful damage having occurred in other districts, the Electric Telegraph Company have given notice that a reward of £5 will be given to any person or persons who shall give information which shall lead to the conviction of any offender or offenders who shall be detected in any way injuring the Company's property.

Dangerous Telegraph Wires.—A correspondent, signing himself "One of the Public," writes to the *Times* on the above subject; the letter is not very perspicuous, but should receive consideration:—"I venture, through you, to draw the attention of the United Telegraph Company (?) to the great necessity of having their wires firmly and securely fastened to those places wherever they may be allowed to carry them across our turnpike roads. As an instance of the danger to which the public are exposed in the event of such precaution being neglected, I may mention that a few days since my coachman's hat was nearly knocked off by one of the company's wires, which, having slipped from the cap on the top of one of the telegraph posts, was hanging across the road. [what road?] Fortunately this displacement of the wire took place in broad daylight; but had it happened at night instead, the affair would have been much more serious, &c."

Electric Telegraphy in Scotland.—At the meeting of the Town Council of Edinburgh on Tuesday, October 25th, the Town Clerk laid on the table a report from the Lord Provost's Committee, under the remit to them to consider and report as to the expediency of connecting the various police-stations with the head office by means of the electric telegraph. After giving the matter all the attention in their power, the Committee recommended the establishment of this communication, the adoption of Siemens, Halske, & Co.'s instruments for that purpose, and suggested that it be remitted to the Lord Provost's Committee to have their resolution carried into effect. The Lord Provost said that in many places the electric telegraph between the various police-stations had been the means of saving property from fire, as well as of detecting crime. The report was approved of.

MISCELLANEA.

Mixture of Sulphuric and Nitric Acids a Solvent of Gold.—A. Reynolds writes to the *Chemical News*, "While examining an alloy of silver and gold for the purpose of ascertaining the percentage of gold that it contained, I found to my surprise, that a mixture of sulphuric acid and nitric acid dissolves gold to a considerable extent. This fact seemed to be of some importance, and being unaware of a similar observation having been hitherto made, I send you a note of it."

On the Respiration of Flowers.—M. Cahours, in a note to the French Academy of Sciences, says, that while the green parts of plants, under the influence of light, absorb carbonic acid, assimilate the carbon, and give out oxygen, the coloured parts, on the contrary, under the same circumstances, absorb oxygen and give out carbonic acid. The amount of carbonic acid evolved seemed to increase as the temperature rose; and a growing flower gave out more than a fully blown one.

The Submarine Cables of the World.—No fewer than 52 lines of submarine telegraph cable have been laid by English firms in different parts of the world, all of which are in successful operation, with the exception of that between France and Algiers, and it is supposed that was injured by lightning. The longest line in operation is that between Malta and Alexandria, 1,535 miles. The deepest water in which any working-cable rests is 1,550 fathoms—1.45 miles—between Toulon and Corsica. The aggregate length of working lines given in the table is 5,105 miles, and this does not include a number of short lines laid in different parts of the world, nor those laid by Felten & Guilleaume, of Cologne, amounting to more than 1,000 miles. One line has been laid 13 years, five have been laid 11 years, four 10 years, and others shorter periods. This estimate does not include the cable lately laid in the Persian Gulf.

The Terrible Effects of Lightning.—Dr. Chretien, of Montpellier, has sent an account to the Academy of Sciences of a remarkable instance of the terrible effects of lightning. On the 2nd ult., he was sent for to ascertain the death of a youth of sixteen, killed instantaneously by the electric fluid in his bed, he being ill at the time. His mother and three young men who had come to see him were in the room when the catastrophe occurred. One of the young men was seated at the foot of the bed, another near the bolster, and the third close to the door of the apartment, which was on the first floor, contiguous to the roof of the house; the mother was between the second and third visitors. The lightning penetrated into the house through the wall of a large room adjoining the sick room; it broke all the window panes in the former before reaching the other where the company were. The young man at the foot of the bed had the legs of his trousers partially burnt off; the second received a wound on one of his legs, and the mother had her left leg cruelly bruised, the stocking was partially burnt, and indeed burns were perceptible on the flesh. Her son, as already stated, was killed, and the fluid ultimately escaped through the window.

Scientific Meeting.—A congress of mathematicians from almost all the states of Europe met in Berlin, on the 15th ult., to make arrangements for re-measuring degrees of longitude in Central Europe.

Heat and Force.—Whenever friction is overcome, heat is produced; and the amount of heat so produced is the exact measure of the force expended in overcoming the friction. Professor Tyndal says, while speaking upon the subject of "Heat Considered as a Mode of Motion:"—"We usually put oil upon the surface of a hone; we grease the saw, and are careful to lubricate the axles of our railway-carriages What are we really doing in these cases? Let us get general notions first; we shall come to particulars afterwards. It is the object of the railway engineer to urge his train boldly from one place to another. He wishes to apply the force of his steam or his furnace, which gives tension to the steam to this particular purpose. It is not his interest to allow any portion of that force to be converted into another form of force which would not further the attainment of his object. He does not want his axles heated, and thence he avoids as much as possible expending his power in heating them. In fact he has obtained his force from heat, and it is not his object to reconvert the force thus obtained into its primitive form. For by every degree of temperature generated by the friction of his axle, a definite amount would be withdrawn from the urging force of his engine. There is no force lost absolutely. Could we gather up all the heat generated by the friction, and could we apply it mechanically, we should by it be able to impart to the train the precise amount of speed which it lost by the friction. Thus every one of those railway porters whom you see moving about with his can of yellow grease, and opening the little boxes which surround the carriage axles, is, without knowing it, illustrating a principle which forms the very solder of Nature. In so doing he is unconsciously affirming both the convertibility and the indestructibility of force. He is practically asserting that mechanical energy may be converted into heat, and that when so converted it cannot still exist as mechanical energy, but that for every degree of heat developed, a strict and proportional equivalent of locomotive force of the engine disappears. A station is approached say at the rate of thirty or forty miles an hour; the brake is applied, and smoke and sparks issue from the wheel on which it presses. The train is brought to rest: how? Simply by converting the entire moving force which it possessed at the moment the brake was applied, into heat."

Reducing Aluminium by Zinc.—*Le Genie Industriel* contains the following description of a new process for obtaining aluminium, recently patented by M. N. Basset, chemist, of Paris. If the statements are correct they are of great value:—"The alkaline metals have been erroneously regarded heretofore as the only reducers of the chloride of aluminium, double or single, and this error has contributed to maintain this new metal at its elevated price. All of the metaloids and the metals which form, by double decomposition, protochlorides or sesquichlorides, more fusible or more volatile than the double chloride of aluminium, may operate the reduction of the salt, as well as of the single chloride; thus, arsenic, boran, cyanagen, zinc, antimony, mercury, and even tin, the amalgams of zinc, of antimony, and of tin, may be employed to reduce the chloride of aluminium single or double. The author intends to apply the legal privilege accorded by his demand for a patent to this general principle as well as to the particular application which follows. He employs zinc by preference in consequence of its low price, of the facility of its employment, of its volatility, and of the property which it presents of metalizing easily the aluminium in measure as it is set free. When there is put in presence of the double chloride of aluminium with zinc [we translate literally] at the temperature of 250° to 300° (centigrade) there is formed chloride of zinc and free aluminium. This dissolves in the zinc in excess, and the chloride of zinc, combining with the chloride of sodium, the mass becomes little by little pasty, then solid, while the alloy remains fluid. If the temperature is raised the mass melts anew; the zinc reduces a new proportion of chloride, and the excess of zinc enriches itself proportionally. These facts constitute the base of the following general process. One equivalent of the chloride of aluminium is melted, and when the vapours of hydrochloric acid are dissipated four equivalents of zinc, in powder or in grain, is introduced. The zinc melts rapidly, and by agitation the mass of the chloride thickens and solidifies. This is the first operation. This mass composed of chloride of aluminium, chloride of sodium, and chloride of zinc, is piled in a crucible or in a furnace and the fluid alloy (*l'alliage coule*) is placed above. The heat is gradually raised to a bright red, and this temperature is maintained for an hour. The melted mass is stirred with a rake, and poured out. It is an alloy of aluminium and zinc in pretty nearly equal proportions. This is the second operation. This alloy melted on some chloride which has been subjected to the first operation, furnishes aluminium containing only a small per cent. of zinc, which disappears by a new fusion under the chloride mingled with a little fluoride, provided the temperature is raised to a white heat and maintained till the cessation of the vapours of zinc, in the absence of air. The aluminium obtained is pure if the zinc employed contains no foreign metals. It suffices to remelt it to cast it into ingots. In case the zinc contains iron, or even if the chloride of aluminium holds a portion of that metal, the metallic product of the second operation may be treated with dilute sulphuric acid. The insoluble residue is washed and melted, layer by layer, with fluoride of calcium or cryolite, and a small quantity of double chloride, destined solely to favour the fusion. The principles and the method which precede, constitute according to the author, a new and economical manufacture of aluminium.

THE APPLICATION OF ELECTRICITY TO GAS ENGINES.—Mr. S. L. Weigand, of Philadelphia, has recently effected some improvements in gas engines which are thus set forth in his specification, an abridgement of which has been published by the American Commissioners of Patents:—First, I claim protecting the piston, or its equivalent, from deposits of residuum in the cylinder by means of a fluid of greater specific gravity than the residuum. Second, combining the conducting electrical points or circuit closing apparatus with the valve gear so that the circuit is closed after closing the valve. Third, combining the regulator with the induction valves so as to regulate the duration of flow of gas and air or other explosive mixture to the cylinder, or its equivalent, by the velocity of the engine, and thus to control the velocity of the engine. Fourth, the induction valves, when constructed and used substantially as described. Fifth, the eduction valves, when constructed and used substantially as described. Sixth, imparting motion to the valves by means of the coupling shafts, in the manner herein-before set forth and described."

A NEW HYDRO-CARBON IN THE COAL-TAR SERIES.—M. A. Bechamp recently announced to the French Academy of Sciences the discovery of a new hydro-carbon in the mixture that makes up coal-tar. In rectifying with care the products which boil between 130° and 150° cent. (266° and 302° Fah.) M. Bechamp observed that the thermometer remained a long time stationary in the neighbourhood of 140° (cent.), a temperature midway between the boiling points of xylole and cumole. Keeping this temperature constant, he separated from 30 measures of brown tar, one measure of a liquid hydro-carbon. A new rectification allowed the whole of this to pass between 139° and 140°. This constancy of the boiling point forbids the supposition that it is a mixture of xylole and cumole. By further purification with concentrated sulphuric acid and sodium the author finally succeeded in producing in the neighbourhood of 900 cubic centimetres of a product boiling from the commencement to the end at a temperature between 139° and 140° (282° and 284° Fah.)—*Le Genie Industriel.*

SIR W. SNOW HARRIS ON THE LAWS OF ELECTRICAL FORCE.—Sir W. Snow Harris, whose researches led eventually to the protection of ships from lightning by the use of conductors, has laid before the Royal Society "further inquiries on the laws and operation of electrical force." He refers to the experiments of Le Monnier, Cavendish, and Volta, as showing that bodies do not take up electricity in proportion to their surfaces; and to the opinion of Volta, that a plain surface extended in length sustains a greater charge, and that this is attributable to the electrical particles being further apart upon the elongated surface, and consequently further without each other's influence. Sir Snow Harris endeavours to show that by extending a surface in length we expose it to a larger amount of inductive action from surrounding matter. No very satisfactory experiments seem to have been instituted, showing the relation of quantity to surface. On a further investigation, the laws of electrical charge, the quantity which any plain rectangular surface can receive under a given intensity, is found to depend not only upon the surface, but also on its linear boundary extension. Hence the charge of the rectangle is much greater than that of the square, although the surfaces are equal, or nearly so. It is from a rigid experimental examination of this question that electrical charge depends upon surface and linear extension conjointly. Every plain surface seems to have what may be termed an electrical boundary, having an important relation to the grouping or disposition of the electrical particles in regard to each other and to surrounding matter. This boundary in circles or globes is represented by their circumferences. In plain rectangular surfaces it is their linear extension or perimeter.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2638. J. Tate, an improvement or improvements in signalling on railways.
2670. W. Dowley, improved apparatus for enabling the passengers in a railway carriage to attract the attention of the guard and driver when required.
2675. A. Parkes, improvements in the manufacture of certain materials and combinations thereof, and the application of the same for waterproofing, insulating, and a variety of other purposes.
2681. L. P. G. Bellet and C. M. P. De Rouvre, certain improvements in the application of electricity as a motive power.
2687. J. H. Simpson, improvements in electric printing for telegraphic and other purposes, and in the apparatus to be used for such purposes.
2690. J. Solomon, improvements in lamps or apparatus for burning magnesium and other metallic substances.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2456. F. Tolhausen, improvements in apparatus for transmitting signals.—A communication.
2461. W. Anderson, improved apparatus for working railway signals.
2463. F. W. Shields, improvements in telegraphic posts.
2512. L. G. Loiseau, a new railway signal apparatus.
2518. M. J. Rice, improved pneumatic apparatus for communicating between passengers and guards in railway trains, as also between the guards, passengers, and engine driver of such trains.
2533. W. R. Sykes, improvements in apparatus for transmitting positive and negative currents of electricity.

PATENTS SEALED.

1126. W. T. Henley, improvements in telegraph wires and cables, and in apparatus used in their manufacture, parts of which improvements are applicable to other useful purposes.
1853. G. Lansdown, a method of providing a direct communication between any guard and any passenger in a railway train.

PATENTS WHICH HAVE BECOME VOID.

2574. T. Forster, improvements in reworking waste vulcanised india rubber.
2606. C. Cheyne and B. Moseley, improvements in the construction of apparatus for signalling on railways, by which improvements for signalling apparatus is rendered self registering or recording, and also applicable for measuring and recording the speed of passing trains and the time of their passage, part of which improvements is applicable for recording the speed of trains where signalling is no t required

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

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INDIA RUBBER.

Para, first quality	1/7 to 1/8	„
second „	1/4 to 1/5	„
third Negro-head	1/1 to 1/2	„
Java and Penang	1/2 to 1/4	„

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TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	103 to 106	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	8	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{3}{4}$ to $\frac{1}{4}$ dis.	—

TO CORRESPONDENTS.

C. EPPS.—Our opinion on the subject will be found in another part of the paper.
W. FROST.—The journal to which you refer was discontinued in June last.
H. K.—Favour us with further particulars, and we will see what can be done to remedy the evil complained of.
J. H. S.—1. The ratio of induction in an iron wire, as compared with copper, premising that the wires are of equal lengths and sectional area, and that they intersect equal magnetic fields, is as 1 : .162; copper being unity, of course this ratio will vary as the qualities of the copper and iron vary. 2. Yes.
E. W. SAMPSON.—Marine glue is made as follows:—Dissolve three parts of india-rubber in thirty-four parts coal-tar naphtha, aiding the solution with heat and agitation; add to it sixty-four parts of powdered shellac, which must be heated in the mixture till the whole is dissolved.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

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THE TELEGRAPHIC JOURNAL.

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A FEW REMARKS ON INDIA-RUBBER.

UNTIL about the year 1819 little was known of the properties of caoutchouc. It was not used for any purpose, except for rubbing out pencil marks, before Mr. Thomas Hancock's attention was arrested by its peculiar properties. This gentleman, in the year above-named, commenced a series of costly, and for a long time fruitless, experiments to determine the best means of rendering rubber fit for the manufacture of articles of utility. Rubber has now become a staple commodity in the commercial market, it is employed extensively in the arts, and, from the circumstance of its being a good insulator of electricity, merits consideration in these pages.

Of the plants that yield caoutchouc the following, classified by Dr. Lindley, are the most prolific:—

I. *Siphonia elastica.*—This, which yields the caoutchouc of Para, is a tree inhabiting dense forests on the banks and tributaries of the river Amazon, where it is called the seringue. The chief district from which caoutchouc is obtained is, according to Wallace, the country between Para and the Xingui river. Another author, Aublet, speaks of the forests of French Guiana as abounding in this plant, where it is called siringa by the Garipon Indians, hevé by the natives of the Esmeraldas, and caoutchouc by the Chainas. According to this writer the trees are from fifty to sixty feet high, and from two to two and a-half feet in diameter. The bark is greyish, and by no means thick; the wood is light and white. The leaves each consist of three or more leaflets, attached by a joint to a long slender foot-stalk, and having an oblong form narrowing to the base; they are green above, but ash-coloured on the under side. The flowers are small, of a greenish hue, and hang in long loose bunches. The fruit is about the same size as a walnut with a rind that separates of itself, and a hard bony shell, splitting with elasticity into half-a-dozen pieces. In each cavity of the fruit are found from one to three seeds, about the size of a filbert-nut, but shining, and mottled with brown upon grey in the manner of the castor-oil seeds. This fruit is agreeable to the taste, and is consumed largely by the Indians, who experience no great inconvenience from eating them, notwithstanding their relation to the West Indian purging nut. Aublet himself was able to eat them without experiencing any unpleasant effects. It was long supposed that there was only one species of siphonia; but the enterprise of Mr. Spruce, a distinguished naturalist, has made botanists acquainted with several others, among which may be included the *siphonia lutea*, found near Panuré, on the river Uaupes; *siphonia discolor*, from the north bank of the Amazon, at its junction with the Rio Negro, and also from Panuré; *siphonia paucifolia* and *siphonia rigidifolia*, from Panuré; and *siphonia spruceana*, from the province of Para.

II. *Hancornia speciosa.*—Under the title of mangaba, or mangava, the Brazilians obtain a fruit the produce of an apocynaceous plant, to which botanists have given this appellation. It is very common in the vicinity of Pernambuco and Olinda, and is also found at Bahia. Gardner describes it as "reaching to the size of an ordinary apple-tree, though its small leaves and drooping branches give it more the appearance of the weeping birch. The fruit is yellow, slightly streaked with red on one side, about the size of a plum, and of delicious flavour. When in season it is brought to Pernambuco for sale." According to M. Claussen, the tree is found on the high plateaux of South America, "between 10° and 12° south latitude, at a height of from 3,000 to 5,000 feet above the level of the sea." The leaves grow opposite each other on the slender branches, about two inches long, oblong, suddenly ending in a blunt point, having a glossy surface, with fine parallel veins. The flowers are slender, tubular, and about one inch and a-half long, growing singly, from among the leaves.

III. *Ficus elastica.*—This plant, indigenous to India, yet so familiar to home horticulturists, is described by Roxburgh. It is known in its native wilds—*i. e.*, the Pundia and Juntipoor mountains, which bound the province of Silhet on the north—by the name of kasmeer, and grows fully as large as the sycamore of this country. The trunk is said to be from five to six feet in circumference, the wood soft, porous, of a light brown colour, and unfit for the uses to which ordinary timber is applied. Its branches are numerous, spreading and rising in every direction, forming a very extensive and shady head. The figs grow in pairs from the base; when ripe they are oval, about the size of an olive, smooth, and of a greenish-yellow colour. Our author says that with the milk, while in its recent state, "the natives of the mountains, a barbarous race, coat the inside of the rude utensils that are intended to hold fluids," and that caoutchouc itself, being inflammable, "furnishes them with candles and flambeaux."

IV. *Urceola elastica.*—Mr. Howison, a surgeon of Prince of Wales' Island, relates that while clearing a way through a jungle with cutlasses it was remarked that a vine had been divided, the juice of which drying on the blade of the weapon possessed the properties of American caoutchouc. The vine was about as thick as a man's arm, with a strong, cracked, ash-coloured bark. It had joints at a small distance from each other; often sent out roots, seldom branches; ran along the ground to a great length, and at last rose upon the highest trees into the open air. It was afterwards met with on the west coast of Sumatra, and other Malay countries. Roxburgh describes its leaves as being opposite on short stalks, oblong, pointed, a little rough, with a few scattered hairs on the underneath. The flowers are small, of a dull greenish colour, and are produced at the ends of the shoots and bunches like those of a lilac bush. The seed vessel is laterally compressed into the form of a turnip, is wrinkled, leathery, and about three inches in diameter.

The best description of rubber is obtained from Para. Stimulated to spasmodic exertions by profits which equal in a very few days the wages of a month given to ordinary work, the half-civilized population of the province, neglecting the culture of the soil, and those industrial pursuits by which they might be permanently benefited, flock to the marshy districts, where the rubber tree is found. There, passing many months of the year with slight shelter, and slighter clothing—regardless of sanitary regulations, and observing no precautions against malaria, which pervades the banks of the Amazon and its tributaries—ravaged by intermittent fevers, and spending in nightly orgies the money so easily acquired, their numbers are fearfully diminished and the population demoralized, with no benefit to themselves and no permanent advantage to the State, which is poorly compensated by a heavy export duty for the sacrifice of its prospective prosperity. As the rubber tree is found upon the public domain, upon which to labour without

restriction is free to all, it is not likely that these pernicious influences will be speedily counteracted. The sole difficulty in procuring rubber is to gain access to the tree. In order to effect this object it becomes necessary to cut paths through the virgin forests. When this is accomplished the Indians make an incision in the tree, about six feet from the ground, and catch the milk, as it flows from the puncture, in rude bowls of clay, which hold about half-a-pint; these vessels are filled in about three hours, if the tree be tolerably fruitful. When the first cutting ceases to yield they make another incision lower down the tree, and so on until four cuttings are made, and the tree is exhausted. After a tree has been once subjected to this process it requires a period of two years to elapse before it is in a condition to yield a further supply. When the process of extraction is concluded the milk is accumulated in larger vessels, subjected to heat, and rendered in a fit state for market.

Previous to 1840 rubber was exported in but small quantities, and chiefly in the form of shoes. After that period, new applications of the material having been discovered in England and the United States, the export of shoes was discontinued, but shipments in bulk largely increased, which increase, owing to circumstances affecting consuming markets, has since been progressive. In the last ten years there has been exported from Para 1,059,952 arrobas of fine rubber, and 378,792 lbs. of ordinary. The Brazilian arroba is rather more than 32 lbs., and hence the total shipments have been upwards of 20,600 tons. Formerly the principal shipments were to the United States, now the largest exports are to the United Kingdom. Last year 65,649 cwts. were received in Great Britain from all quarters. From the Port of Guayaquil, on the coast of the Sea of Ecuador, 2,227 cwts. were shipped in 1863.

"Caoutchouc," says Professor Brande, "is sometimes called *gum elastic*, but it has none of the characters of a gum, being perfectly insoluble in water; nor is it a resin, for it is insoluble in alcohol; but ether, which has been washed so as to deprive it of alcohol, dissolves it, with the exception of impurities, and leaves it on evaporation in its perfectly elastic state; it also dissolves in chloroform, and in sulphuret of carbon, and in some of the essential oils; but its most common and useful solvents are rectified naphtha and oil of turpentine."

The uses of rubber are as various as the requirements of the public; it is susceptible of manipulation for a thousand purposes; but what concerns us most, in a proper application, it is by far the best material for the manufacture of submarine telegraph cables. Mr. Latimer Clark, in his evidence before the Submarine Telegraph Committee, when asked his opinion of caoutchouc as an insulator, replied, "It stands very high indeed as an insulator, and its specific inductive capacity is very low"—two of the most important requirements in telegraphy—"therefore, as a material it is peculiarly well adapted for use in submarine cables, and it has the great advantage that high temperature does not injure it. I have seen many pieces of it in a state of decomposition from causes which at present I do not understand. By some it is attributed to the action of the copper, by some to the use of greasy wire in the manufacture, and by others to the use of an inferior rubber. I have had specimens which were laid down by my brother, Mr. Edwin Clark, in 1850, in several tunnels on the Lancashire and Yorkshire and North-Western Railways. I have also examined specimens which were laid in the Box tunnel long prior to that time. All those specimens have cotton round the copper wire before the india-rubber is placed in it, and I find that no particular decay has taken place in these wires, and they give me the impression that india-rubber will eventually prove to be a highly permanent material." Similar testimony is borne by Mr. John Fuller, in his evidence. He says: "The insulating property of india-rubber is admitted on all hands, and its less induction is a well-known fact. These are facts which I saw at once on entering on the manufacture. It was not generally known, and no one would receive it as correct; many gentlemen that I spoke to about the less induction of india-rubber had no idea of such a thing, and they could not think it possible. There was a notion existing among electricians a year ago that the greater the insulation, the greater would be the induction." Mr. Varley recommends the application of india-rubber in its native state, and asserts that, if wires were treated with caoutchouc in this condition, "an insulator would be obtained far superior to gutta-percha, very tough, sound, and not liable to decomposition." * * * * "Added to which, the inductive capacity of india-rubber is much lower than that of gutta-percha, and consequently the speed of transmission through an india-rubber covered wire would be much higher than that through a gutta-percha covered wire." Notwithstanding these emphatic declarations of the superiority of india-rubber as an insulator over gutta-percha, the latter material is now the more generally employed in the manufacture of submarine cables. There are undoubtedly several conditions to be fulfilled in the coating of wire with india-rubber, but these are now perfectly well understood, and several patents are extant for improvements in the application of caoutchouc, which remove hitherto believed-in defects to a reminiscence. Messrs. Wells & Hall affirm that in no instance in which their patent has been conformed to have their wires shown the slightest indication of decay. Mr. Hooper advocates the use of vulcanized rubber—*i.e.*, caoutchouc treated with sulphur—(which resists the influence of water in a remarkable degree), and alleges that this is the most effective insulating material ever produced. Messrs. Macintosh guarantee perfect insulation in long lengths of deep-sea cable, and perfect protection from oxidation and the ravages of marine insects. One great objection to the employment of india-rubber for submarine cables was the difficulty of making joints in the material. All occasion for uneasiness on this account is now removed, for Mr. Hooper's recent experiments prove conclusively that joints can be made so perfect as to defy detection. "Caoutchouc, like gutta-percha," says Dr. Miller, "is liable to deterioration by exposure to the action of oxygen in the presence of solar light." This fact is readily admitted, but the means now available for the protection of cable cores from the action of oxygen, both in air and in water, lead us to hope that the day is not far distant when this valuable vegetable product will supersede its more costly and less efficient rival. On its intrinsic merits rubber should have been employed in telegraphy far more extensively than it has hitherto been. Vested interests have long stood in the way of its application, but the facilities which have been offered patentees, for bringing the claims of their inventions before the public, by the Joint-Stock and Limited Liability Companies' Acts, will tend in no small degree to break down the monopoly which has existed too long for the good of telegraphy.

THE WONDERS OF THE WORLD.—The greatest cataract in the world is the Falls of Niagara, where the water from the great Upper Lakes forms a river of three quarters of a mile in width, and then, being suddenly contracted, plunges over the rocks in two columns to the depth of 170 feet each. The greatest cave in the world is the Mammoth Cave in Kentucky, where any one can make a voyage on the waters of a subterranean river, and catch fish without eyes. The greatest river in the world is the Mississippi, 4,100 miles in length. The largest valley in the world is the Valley of the Mississippi. It contains 500,000 square miles, and is one of the most fertile and profitable regions of the globe. The largest lake in the world is Lake Superior, which is truly an inland sea, being 430 miles long. The greatest natural bridge in the world is the Natural Bridge over Cedar Creek in Virginia. It extends across a chasm 80 feet in width and 250 feet in depth, at the bottom of which the creek flows. The greatest mass of solid iron in the world is the Iron Mountain of Missouri. It is 350 feet high and two miles in circuit. The largest number of whale-ships in the world are sent out by Nantucket and New Bedford. The greatest grain port in the world is Chicago. The largest aqueduct in the world is the Croton Aqueduct in New York. Its length is 40½ miles, and it cost twelve and a half million of dollars. The largest deposits of anthracite coal in the world are in Pensylvania—the mines of which supply the market with millions of tons annually, and appear to be inexhaustible.—*American Artisan.*

ELECTRIC TELEGRAPHS IN THE UNITED KINGDOM.

The Government returns are, perhaps, the most reliable data on which conclusions as to the progress of the telegraphic system can be based; and although these are not very comprehensive in character, they afford at least information which it would be difficult to procure from private sources. In a recent issue of this journal we stated that a more extensive business might be transacted on telegraph lines without any perceptible increase in the working expenses. This statement is strikingly corroborated by an official document presented to both Houses of Parliament, from which it will be seen that in several instances the mileage has not been materially augmented, while the traffic has increased from 10 to 20 per cent. on the previous year's operations.

From a volume of Miscellaneous Statistics, recently published, we extract the following tabular statement of electric telegraphs open to the public in the United Kingdom in each of the years 1861, 1862, and 1863:—

Telegraph Companies.	Length in Miles of Telegraph Lines.			Length in Miles of Wires used.			Number of Stations open for the Public.		
	1861.	1862.	1863.	1861.	1862.	1863.	1861.	1862.	1863.
Electric and International	6,727	7,597	8,230	32,787	35,066	39,042	772	909	1,022
British and Irish Magnetic*	3,903	4,126¼	4,196¾	17,043	16,733½	17,257½	401	449	464
South-Eastern Railway†	309½	314	316	2,432	2,484¼	2,642¼	89	92	94
London, Brighton, and South Coast Railway	192	199½	212	396½	454	541½	35	60	46
London District‡	92¼	103	107	378¼	401	430	78	84	81
The United Kingdom	305	371¾	831§	1,968	2.741	5,099§	16	22	48§
Total	11,528¾	12,711½	13,892¾	55,004¾	57,879¾	65,012¼	1,391	1,616	1,755
Submarine. (Telegraph to Calais, 24 miles; to Boulogne, 25 miles; to Dieppe, 78 miles; to Jersey, 30 miles; to Ostend, 70 miles; to Hanover, 80 miles; and to Denmark, 380 miles)	887	887	887	2,484 Submarine.	2,683 Submarine.	2,683 Submarine.	474 in United Kingdom, and about 3,000 in Foreign Countries.	Upwards of 3,000 on the Continent.	Upwards of 3,000 in Foreign Countries.

Telegraph Companies.	Number of Instruments.			Number of Public Messages.		
	1861.	1862.	1863.	1861.	1862.	1863.
Electric and International	3,529	4,003	4,489	1,201,515	1,534,590	not ascertained.
British and Irish Magnetic	1,084	932	1,042	689,738	671,550	827,424
South-Eastern Railway	135	145	142	55,085	62,825	62,968
London, Brighton, and South Coast Railway	131	156	159	21,680	30,024	43,208
London District	188	198	192	144,022	243,849	247,606
The United Kingdom	65	88	172	11,549	133,514	226,729
Total	5,132	5,522	6,196	2,123,589	2,676,352	——
Submarine	54 exclusively for Continental traffic.	23 exclusively for Continental traffic.	51 exclusively for Continental traffic.	About 230,000 to and from Foreign Countries.	310,595 to and from Foreign Countries.	345,784 to and from Foreign Countries.

* The number of messages to and from the Continent transmitted jointly by this company and the Submarine Telegraph Company, and the number of messages for railway companies, newspapers, and news-rooms, are not included with the messages for the public, but are estimated at about 250,000 messages per annum.

† The South-Eastern Railway Company has no working arrangements with either of the electric telegraph companies.

‡ Exclusive of private telegraphs provided by this company for firms and persons having two places of business, and the London Fire Brigade system of telegraphs.

§ This additional mileage and stations was only completed and opened in November, 1863.

THE RUSSIAN-AMERICAN TELEGRAPH.

ALTHOUGH our readers may be well posted in this project, an account of its inception, the leaders in the enterprise, the route to be followed, and the date on which it is expected that Russia and America will be joined together by the telegraph—all these particulars from the pen of the Cleveland correspondent of the *New York Herald*—will doubtless prove interesting:—

"The subject of a telegraph between the continents has been agitated ever since the magnetic telegraph was known to be a success. Various routes have been proposed, and on one the experiment has been tried, and is about to be repeated. That a cable can be successfully laid between Newfoundland and Ireland has been demonstrated to the world; the matter of its permanent success remains to be tested. This will be tried by the new cable, to be laid down under the direction of Mr. Field. The experience of telegraph men is not generally in favour of submarine lines, though there are several that have been working well through a series of years.

"The managers of the Western Union Telegraph Company have been for a considerable time looking at the project of a telegraph to Europe through Asiatic Russia. The company now have their lines extending from Buffalo and Pittsburg as far west as Salt Lake City, where they connect with a California line to San Francisco and Oregon. They touch all the principal cities of the West, and form a very important link in the girdle that Puck would put about the earth in forty minutes. Such uniform success has attended their enterprise that they are constantly desirous of extending their power, and from the first moment of conceiving the design of an intercontinental telegraph they have never allowed tho subject to rest.

"The new company is organised with a capital of ten millions, and is to be distinct from the Western Union, though controlled by the managers of the latter concern. J. H. Wade, of Cleveland, is President of the Company; Colonel Anson Stager, George B. Hicks, Hiram Sibley, and others whose names are not now at hand, are directors and leaders in the enterprise. The offices of the company are in this city in the Western Union building. A large number of telegraph men throughout the country are interested in the success of the work. Mr. Perry McD. Collins has been the labourer broad with the Emperor of Russia to secure the privileges which the company have obtained.

"The friendly feeling expressed by Russia towards the United States has aided much in the preliminary work. As soon as the subject was proposed to the Emperor he expressed his hearty concurrence in the plan. After some time he proposed to build a line half way from St. Petersburg to Washington, on condition that the United States would build the other half. Nearly every enterprise in Russia, whether of railway or telegraph, is carried out by the Government, and not by private effort. At first the Emperor hesitated to grant privileges to a private company, but after a time he consented to do so. The American company has obtained a perpetual charter, which is exclusive for three years, for the building and working of a line through the Russian possessions to the mouth of the Amoor river. This point is about half way between St. Petersburg and Washington. The Russian portion is finished from St. Petersburg to Irkoutsk, and from the mouth of the Amoor three hundred miles west, leaving but about nine hundred miles unfinished. This will be completed during the present season, and is all paid for by the Russian Government.

"Mr. Wade, the President of the American company, thinks the line will be working from Washington to St. Petersburg in two years from the present time. A year will be consumed in fixing upon a route and in distributing material, and when this is accomplished the greatest difficulties of the enterprise are overcome. The route to the Pacific coast is not yet fixed. One route proposed is from Fort Laramie, or Salt Lake City, through the Idaho gold mines to Portland, Oregon. Another is by way of St. Paul, Minn., through Fort Garry and the Selkirk settlement of British North America to Victoria and Vancouver's Island. Thence it is probable the line will follow the coast by the fur posts of the Russian Fur Company to Behring's Straits, and thence down the Asiatic coast to the mouth of the Amoor. In case any unforeseen difficulties present themselves in Behring's Straits, it is proposed to lay a cable from Cape Romanzoff to Isle St. Lawrence, and thence to the Asiatic coast at Cape Tchuktchi. A glance at a large map of the world will show that this route is shorter than the one by Behring's Straits, though it requires a cable of greater length.

"The chain of the Aleutian Islands was first proposed, but is not at all likely to be adopted. It would require an immense number of submerged wires, and be in danger of being frequently out of order. The Western Union Company's experience with its cables at crossings of rivers is not such as to induce belief in their general feasibility. So little is the reliance upon their success, that they propose to keep a steamer constantly at Behring's Straits, with cables on board ready for laying whenever the line shall give out. The smallest accident may disable a submerged wire, and when once broken there is no means of repairing. The Aleutian Islands chain requires such a series of cables that a single steamer would not be sufficient for the purpose.

"In addition to their charter as a telegraph company, the new concern has received the right to trade anywhere in Russian territory. Hitherto trade has been exclusive with the Russian Fur Company. This company, like the Hudson Bay Company, has lost the charter for exclusiveness; but the trade has so far diminished in the past few years that it is not now worth the formation of rival companies for purposes of trade alone. The telegraph company could be a formidable rival in the matter of trade, as it would carry on the business in connection with its direct enterprise. The Russian company has proposed that an arrangement be made that shall be mutually advantageous. This will probably be done, and the telegraph and fur companies work in harmony. The former will make use of the ships, posts and men of the latter to build and keep the line in order, and will make no interference in trade matters.

"A ship is about to sail from New York with material for the line. Captain Bulkley, who has charge of the Company's interest on the West Coast, has already left for San Francisco, and will be ready to distribute the material as soon as the ship arrives. Mr. Collins has gone to Europe to further the company's interests in that quarter, in England and Russia. Nothing now stands in the way except the completion of the line.

"To give an instance of the rapidity of telegraph building, when set about in earnest, I will state a fact of history in connection with the Pacific line now in operation. Early in 1861 Mr. Wade went to California to arrange about their connections. He contracted with a California company to meet them at Salt Lake. In order to stimulate all parties to exertion, it was stipulated that the one first opening its line to Salt Lake City should receive fifty dollars a day forfeit from the other, as well as the earnings of both ends of the line, until the two routes joined. The Western Union Company had not expected to build the line that year; but, under the stimulus of Mr. Wade's contract, they set to work and pushed through in about four months. The cost of construction was actually less than if they had taken plenty of time for the work.

"The line from Omaha to Salt Lake runs through the Indian country, and a part of the way is off the main travelled route. There are less derangements than between Buffalo and St. Louis, and the managers say that it works more hours in a year than their other lines. They assert that they prefer an uninhabited to a well settled country, as far as working the route is concerned. One feat has been performed on this line never performed in civilisation. On several occasions the operator at Chicago has worked through to Salt Lake, sixteen hundred miles, without repetition. The wonderfully dry atmosphere on the Plains is highly favourable to telegraphing.

"During the late Indian troubles the red men never interfered with the wires. This is due to a ruse practised on them by Mr. Creighton, Superintendent between Fort Hearny and Salt Lake City. Mr. Creighton caused them to believe that the telegraph was the breath of the Great Spirit. Thus believing, they carefully abstained from interfering."

EFFECT OF LIGHT ON THE MAGNETIC NEEDLE.—Few persons are aware that light exerts a perceptible effect on the action of the magnetic needle. The Swedish philosopher, Wrede, totally excluded light from his magnetic observatory, with the exception of a subdued light, at a considerable elevation, vertical to the horizontal needle, while the arc was read off by a telescope, at a distance of several yards from the instrument. Means with the same end in view ought to be adopted in every magnetic observatory, otherwise no reliance can be placed on the observations. It is evident that the more deliberately the magnetic needle is suspended, the more obnoxious it will be to the effect of artificial light in the operation of reading off the instrument. In proof of the effect of every description of light on the magnet, Sir John Ross mentioned that during his last voyage in the Felix, when frozen in about 100 miles north of the magnetic pole, he concentrated the rays of the full moon on the magnetic needle, when he found that it was five degrees attracted by it.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XV.

A.D. 1840, January 21.—No. 8345.—Wheatstone, Charles, and Cooke, William Fothergill.—"Improvements in giving signals and sounding alarms at distant places by means of electric currents," consisting of:—

A signal apparatus, by which the letters of the alphabet are presented at an opening in a dial plate, by means of an electro-magnet in the circuit, which acts upon the pallets of an escapement similar to an "echappement à cheville," put in motion by independent clockwork. When the electric current passes, the electro-magnet attracts a keeper attached to the end of a "sliding spindle" carrying the pallets, which action takes away the detaining pallet, releases a tooth of the escape-wheel on the dial axis, and brings the other pallet into action, so that the wheel is advanced only half a tooth. On the electric current ceasing, a spring restores the sliding spindle to its original position, and enables the escape-wheel to advance another half tooth; and so on until the required signal appears at the dial plate opening, when a pause is made, and the same process gone through for the other signals. The escape-wheel may be driven without clockwork, by means of spring pallets (attached to a sliding spindle parallel to its axis) in connection with the electro-magnet and reacting spring. A magnetic needle and coil may also be used (by reversing the electric current) in connection with pallets and an escape-wheel, to give motion to the dial.

A "communicator," having a dial plate similar to that of the signal apparatus, and radial arms to work it, one to each signal. Under the dial is a metallic circle inlaid with wood, the metal of which is connected with one circuit wire, the other circuit wire from the battery being only brought into metallic contact with it when a spring is in contact with the metallic portion of the circle. The rotation of the dial plate by the operator makes and breaks the circuit alternately, so that when this instrument is used in connection with the signal apparatus, it moves the disc according to the signals required to be given. When the communication is finished, the dial plate is made to indicate blank, and the main circuit is completed by means of a single inlaid piece of metal in a wooden circle, against which a spring presses, thus enabling signals to be received; at the same time connection with the battery is broken.

An electric alarum. In the signal apparatus, the electro-magnet is mounted upon a "slider," so as to be moved, by a suitable "stem," opposite to another piece of soft iron fixed to a sliding spindle (carrying a detent) that releases the fly-wheel of the alarum clockwork whenever the electric current passes round the magnet in that position. This train has a "serrated wheel," which "by acting on suitable pallets, moves the hammer of the alarum backwards and forwards so as to strike the bell."

An alarum apparatus, in which a hammer is made to strike upon a stop at certain regular intervals by clockwork always in motion; when a magnetic needle is deflected by the completion of the circuit, it places itself against a detent, so that the hammer strikes upon it, releases the clockwork, and enables the alarum to sound. An electro-magnet and keeper may be used, instead of the coil and needle, to enable the hammer to act on the detent.

A magneto-electric machine, that may be used in connection with the signal apparatus above described. The current is made to circulate in one direction by means of an inlaid wooden disc on the axis of the armature, in connection with springs in metallic contact with the main wires; the disc is inlaid with two insulated metallic semicircles respectively in connection with each terminal of the armature coil; thus the to-and-fro current generated by the machine is reversed. The machine is driven by a cog-wheel and pinion, the cog-wheel having twelve pins, so disposed that, by the motion of the wheel through a space equal to the distance between them, the armature moves through half a revolution. Twelve signals are thus made without the "communicator," and are all that this machine can make with the above described signal apparatus, as its electric current is only of momentary duration, and the electro-magnet cannot act a sufficient time to convey a signal by stopping the pointer.

A signal apparatus, in which the force of two electro-magnets in the circuit is made to act, through pallets and an escape-wheel, on a hand or moveable dial without the reaction of a spring. The pallets have a tail-piece (free to vibrate between the poles of the two electro-magnets) which is attracted to one of the electro-magnets when the instrument is at rest, in consequence of the circuit including the electro-magnets being then closed; by this means the clockwork is prevented from running down. Three main wires are used with this instrument; one which connects dissimilar poles of the batteries; a second connecting similar terminals of the "right-handmost" magnetic coils; and a third connecting similar terminals of the "left-handmost" magnetic coils. When the circuit is completed through the two main signal wires, so that each conveys half the electric current, both the magnets are excited and the signal apparatus can receive signals. The "communicator" is placed concentric with the dial, and the current is conveyed to the magnets alternately, or both at once, by means of a pinion whose axis carries a metal wheel inlaid with wood with which the remaining battery wire is connected, and against which springs, connected with the remaining coil terminals, press; the pinion is moved by a toothed wheel on the dial axis. In order to enable intermediate stations to work this signal apparatus with the batteries at the terminal stations, the intermediate apparatus have two inlaid metal wheels, one for each magnet; this instrument is portable. The dial or hand may be worked by the electro-magnets only, a detent to ring an alarum (when a stop is pulled out) may be released by the completion of the circuit without shifting the magnets, and the keepers of the magnets may be attached to the pallets themselves. In all the above signal apparatus, either a dial revolving behind a perforated dial-plate, or a hand revolving over a fixed dial-plate, may be used. Letters Patent, Nos. 7390 and 7614 are referred to.

A.D. 1840, March 3.—No. 8407.—Shore, Joseph.—"Improvements in preserving and covering certain metals and alloys of metals." This invention "relates to a mode of obtaining or applying a permanent covering of copper or of nickel by means of galvanic batteries on articles manufactured of wrought or cast iron, tin, lead, and copper, and of alloys of such metals, such covering acting as a preservative to some of those metals and alloys of metals, and in other cases as a superior surface." For this purpose "an open vessel" "of wood or of earthenware," divided "into two compartments by a partition of unglazed earthenware or other porous substance," is taken. Into one of the compartments "pure water slightly acidulated, by preference, with sulphuric acid," is placed; and into the other a solution of "sulphate of copper or nitrate of nickel, whichever is to be used, as the "covering metal." These metallic solutions must be "kept up to a neutral strength." A piece of zinc is placed in the first-mentioned compartment, and connected by a copper wire to the article to be covered, which is placed in the metallic solution. The articles are, preferably, cleansed by submitting them to a low red heat when covered with sand, charcoal, or black lead, in a crucible, and "permitting the same to cool" before covering them. The solutions may be either used hot or cold, and "the longer the articles are under operation the thicker the covering." Large articles are covered separately, "small articles, such as iron rails" [nails?], are placed in a wire "basket" connected by a wire to the zinc plate. The article should be "moved, from time to time, to prevent any part or parts being left uncovered."

A.D. 1840, March 25.—No. 8447.—Elkington, George Richards, and Elkington, Henry.—"Improvements in coating, covering, or plating certain metals," consisting of:—1st. "Coating," &c., "copper and brass with silver," by immersing the article, cleaned and silvered (See Letters Patent, No. 7496, or the second improvement hereinafter mentioned) in a solution of nitrate of silver; expelling the acid by heat; and fusing on the coating by immersion in fused borax; the cooled article is then boiled "in dilute sulphuric acid" "until the adhering borax is all dissolved." "For a finish," the article is preferably electro-coated with silver, as hereinafter described. 2nd. "Coating," &c., "metals with silver." The cleaned articles are, by preference, immersed in a solution of oxide of silver in "prussiate of potash (cyanide of potassium)" by boiling. For a thicker coat a galvanic current is used, by means of a single cell apparatus. Oxide of silver must be added "from time to time." "Prussiate of soda or other analagous salt," or "pure ammonia," may be used either with or without a galvanic current, or a "neutral salt" of silver in connection with a galvanic current, the article having previously received a thin coating by the "cyanide of silver" solution. 3rd. "Coating," &c., "metals with gold." The cleaned articles are, preferably, immersed in a solution of comminuted gold, or oxide of gold, in "prussiate of potash" by boiling. For a thicker coat, a galvanic current is used as described for silver. The solution must be kept "saturated with gold." Double

and "haloid salts" of gold, and oxide of gold, or metallic gold dissolved in "any soluble prussiate, or "any other analagous salt," may be used, either with or without a galvanic current, as for coating with silver. In these two last-mentioned improvements the article may either be of metal or coated with metal. 4th. Iron is prepared "for receiving a coating of copper," &c., by immersing it, connected with a strip of zinc, in dilute sulphuric acid, thus causing it to be "electro-negative" whilst cleaning. It is then placed in a "brass vessel" containing an acid solution of sulphate of copper, and having thus received "a thin film," is ready to be covered with any metal by a galvanic arrangement similar to that described for silvering, or "by other known means."

A.D. 1840, May 7.—No. 8499.—Grover, Henry Montague.—"An improved method of retarding and stopping railway trains." This invention consists "in the application of the powers of an electro-magnet, or of electro-magnets, or of magnetism generally, whether applied directly or indirectly to any wheel or wheels upon which a train or any portion of a train of carriages, or other vehicles upon any railway, moves, or in any other manner." The specifications and drawings describe and show an electro-magnet "applied to the face of the tire of one wheel of a railway carriage, called a truck." An electro-magnet is fitted into a wooden block or box, covered with a lid, and is suspended from a transverse rod at the bottom of the truck, so as to hang within "half an inch, more or less, according to the power of the magnet from the tire of the wheel." On the connection of the wires from the battery, which is placed in the truck, the adhesion of the electro-magnet to the tyre of the wheel "will impede or totally prevent its turning round, and thus retard or stop the train of which the carriage, the wheel of which is thus acted upon, forms a part. Any number of the wheels of a carriage or train may, of course, have these magnets applied to them, and the retarding of each such wheel will be in proportion to the power of the magnetism so elicited and applied."

A.D. 1840, August 27.—No. 8610.—Lockett, Joseph —"Certain improvements in manufacturing, preparing, and engraving cylinders, rollers, or other surfaces for printing or embossing calicoes or other fabrics," relating to:—1st. The application of galvanic electricity to "recoating, covering, or thickening" the cylinders, &c., used for calico printing; or to make new cylinders. This is done by taking a "mould or shaft," which may either be a conductor of electricity and "retained as a portion of the cylinder," or a non-conductor "subsequently rendered a conductor" by any of the usual means, and then removed from the cylinder when it has attained the requisite thickness." The "mould" is then covered with copper by the ordinary process of electro-deposition. 2nd. A "method of preparing surfaces by galvanic or voltaic electricity, applicable to cylinders, plates, or blocks for printing or embossing calicoes and other fabrics." When any of the engraved ground is required to be obliterated or "rendered plain," those portions are left exposed, whereas the rest of the surface is coated with varnish; the exposed part is then coated with copper by galvanic agency in the usual manner. 3rd. A "mechanical contrivance" for "cleaning, filing, or turning off the superfluous portions of the copper thus deposited upon rollers or cylinders." This consists of a "rotary cutting or filing tool" applied "either to the ordinary slide lathe or the engraving machine commonly used for cylindrical engraving" and acting upon the cylinder, the cylinder being properly "supported by and revolving on the mandril" of the lathe. The "filing tool" is carried "from end to end of the roller" by a screw extending the whole length of the lathe, "or it may be slidden to any part of the bed by hand or otherwise," and has proper adjustments for regulating its speed and depth of cut.

A.D. 1840, September 10.—No. 8625.—Dent, Edward John.—"Certain improvements in clocks and other timekeepers," consisting:—1st. "In giving the impulse to the pendulum of a clock at the centre of percussion, or as near as practicable to that centre." 2nd. "In producing a compensation for the expansion and contraction of the length of the pendulum arising from changes of temperature, by causing the arcs of oscillation to vary in an inverse ratio to the variations of the length of the pendlum" [pendulum?]. 3rd. "In combining three or more main springs and barrels to act simultaneously, without the medium fuzee, upon the train of wheels of a chronomer" [chronometer?] "or other timekeeper." 4th. "In connecting three or more main spring arbors with a common arbor, whereby all the springs may be wound up at the same time by one application of the key." 5th. "In withdrawing, as much as practicable, the atmospheric air from the interior of an air-tight case containing a chronometer, and in filling the space with a dry non-corroding gas, such as hydrogen." 6th. "In *the application of the well-known voltaic or electro-metallurgic process* to the depositing of a thin film of gold or other metal, incorrodible by the atmosphere, upon the steel balance spring and the compensation balance, the surface of which having been cleaned with alkali or acid immediately previous to the application, in order that the metallic adhesion may be perfect and rust prevented, and consequently one cause of variation in the rate of chronometers is thus avoided."

A.D. 1840, September 24.—No. 8644.—Pinkus, Henry.—"Improvements in the methods of applying motive power to the impelling of machinery, applicable, amongst other things, to impelling carriages on railways, on common roads or ways, and through fields, and vessels afloat, and in the methods of constructing the roads or ways on which carriages may be impelled or propelled," relating to:—1st. "Propulsion on railways" by means of the "gaso-pneumatic" force. 2nd. "Propulsion on canals" by means of the "gaso-pneumatic" force. 3rd. "Applying the aforesaid gaso-pneumatic principle to impelling machinery, to wit, the impelling engine described in my said former specification, dated twenty-fifth day of February, 1841," [Does not this refer to No. 8207, which was enrolled February 25, 1840?] and to "the purpose or purposes of a fire-engine." 4th. "Effecting propulsion" on railways or canals by "steam power, in combination with the same, or parts of the same impelling machinery or apparatus, in lieu of gaso-pneumatic power." 5th. Effecting propulsion on railways, common ways, and canals, and through fields, by the application of electrical force, however generated. This invention is applied to agricultural purposes, by either erecting a central station in which "an electric battery or batteries" are placed, or constructing "wells or tanks," too deep in the ground to interfere with agricultural operations, from which pipes containing bundles of insulated wires are laid, having at convenient places "vertical branches" with "boxes," in which are the loose ends of the wires; the wires are coloured to distinguish their electric polarity. "To put implements into action, a locomotive engine is constructed, with a drum carrying and winding up the battery wires, and a "Taylor's" (See Letters Patent, No. 8255?) or any other electro-magnetic engine. Trains are stopped by electric agency as follows:—Batteries are placed at convenient distances along the line, and between each line of rails a light hollow "railway bar" is laid (in half mile lengths), having continuous bars of wood carrying two copper strips insulated from one another; the copper strips are in connection with two insulated wires in the interior of the hollow rail, thence with one of the batteries. By means of "an electro-magnetic coupler" "composed of two masses of copper," insulated from one another, and suspended by a moveable joint to the locomotive engine, the stationary battery is connected at will with a "Taylor's" (or any other) electro-magnetic engine on the locomotive, which enables any person having charge of the railway to shut off the steam and blow the whistle. The "Taylor's" engine acts on the shut-off valve and steam whistle by means of a pulley, cord, and lever. A similar apparatus may be placed in the break carriage, and actuate the break when required. An electro-magnetic break is described, in which "a flexible armature" of "thin laminated plates lying one on another," is attracted to an electro-magnet, and actuates suitable levers. To prevent collision, a battery on the locomotive may complete the circuit, whenever it gets on the same half mile length as another train, through the strips on the wooden bars. "Taylor's rotary wheel," or any other electro-magnetic engine, may be used as "the moving power on a locomotive engine," "by taking up the electric force from the wires" laid down between the rails. An electro-magnetic beam engine is described and shown, consisting of electro-magnets with horizontal surfaces, on each side of the beam, acting alternately on a "flexible armature," "formed of thin laminated plates lying on one another," with one edge of which they are connected, thus enabling the beam to vibrate, and rotate a fly-wheel. This engine has a circuit breaker, consisting of a weighted lever in contact with one or other of two plates, according as a hammer jointed to an excentric stud on a rotating "circular cam" rests upon the lever plate or not. The electro-magnetic force may be used on canals by means of the "dynamic impeller;" this consists of a frame travelling on a "suspension rail" (one of which is laid on one or both margins of the canal). To keep it properly balanced on the suspension rail, the dynamic impeller has, besides "travelling wheels," "adhesion wheels" bearing against the sides of the rail, on whose axis pullies are attached, that carry a "cord or tow rope" passing round a pulley in the vessel; there are also weights to keep the principal weight below the centre of gravity. The wooden bars

carrying the battery wires are supported on each side of the rail, and an electro-magnetic engine may be placed either on the "impeller" or in the vessel. The electro-magnetic force may be applied to railways by means of a "differential railway." Fixed engines, erected at suitable distances apart, give motion to bands passing round horizontal wheels mounted between the rails, the bands thus traversing beneath the carriages. The motion is communicated to the carriages by pullies or "impelling wheels," in a trench, at certain distances apart, which work into a flange bar at the bottom of the carriages. The electro-magnetic force may also be applied to putting "impelling engines" in motion, in manufactories, by establishing "electric metallic circuits" from fixed stations containing batteries. "The combinations of method and apparatus" set forth in this specification for applying electric currents may be used "for the purposes of lighting places." "The valve main of the gaso-pneumatic railway" may be unsealed by a heated electric wire.

A.D. 1840, October 1.—No. 8650.—Talbot, William Henry Fox.—"Improvements in producing or obtaining motive power" by means of galvanic electricity. In one engine, the galvanic current is made alternately to generate the mixed gases from the decomposition of water under a piston, and to explode those gases, thus giving motion to a fly-wheel shaft. In a second engine, a lever is moved downwards, and then up again, by means of an electro-magnet, and the reactive force of a rod free to move after the armature has reached the magnet. The temporary magnetism attracts the lever (it being fixed to the armature) till the armature comes into contact with the magnet; the electric current then ceases, but a rod (passing through a hole at the end of the lever) attached to a crank, continues moving, and on its upward motion raises the lever, which is then ready to be again attracted by the magnet. A variation of this plan is described and shown, in which the armature merely rests in the lever, and several magnets and armatures may be used; in this case the lever itself continues its motion after the armature is in contact with the magnet. Other plans may be used, in which only the armature itself is stopped, the rest of the machinery continuing its motion. In a third engine, motive power is obtained by the alternate expansion and contraction of a gas, vapour, or fluid, heat being applied and withdrawn at proper intervals by a galvanic battery. A strong iron U-shaped tube, partially filled with mercury, has one leg in connection with a piston, the other leg closed at the end and filled with solid carbonic acid; this soon liquifies, a part becomes gaseous, and motion of the piston is produced by passing a galvanic current, at proper intervals, through a thin piece of metal (thus heating it) in the carbonic acid.

A.D. 1840, October 7.—No. 8656.—Spencer, Thomas, and Wilson, John.—"Engraving metallic surfaces" by means of "voltaic electricity." The surface to be engraved is coated with varnish or "etching ground;" the required drawing "is then made with a pointed instrument;" the surface thus prepared is "put into communication with the copper or negative end of a voltaic arrangement," and placed in a vessel containing a suitable solution opposite to a "conducting surface," "which communicates with the zinc or positive end" of the battery. "During the process the engraved plate may be withdrawn and examined," and, if necessary, replaced. "When some of the lines are required to be fainter than others, such parts of the design may be stopped out." Or the etching may be done in one vessel, by connecting the prepared surface with a surface electro-negative to it in a suitable solution. Or the prepared plate may be placed "in a solution between the plates forming the poles or ends of the voltaic apparatus."

A.D. 1840, October 15.—No. 8663.—Pinkus, Henry.—The title of this invention is, "An improved method of combining and applying materials applicable to the formation or construction of roads or ways." The invention consists of:—

"Methods of combining materials so as to form foundations as bases for superstructures of roads, ways, streets, or rail or tramways, and applying to said combination fixtures so as to suit said combinations or structures to the impelling of common or improved vehicles thereon." Various modes of forming the foundation and superstructure of street and other paving stone, brick, wood, asphalt, and "artificial granite," are set forth, and the structure is called "the textile or woven pavement."

"An improved locomotive impeller" for ascending inclines on railways, applicable "to any kind of locomotive engine, whether of steam, gaso-pneumatic, or electro-magnetic." Two horizontal "adhesion wheels," affixed to the locomotive, are made to rotate with the same peripheral speed as the driving wheels, and are pressed upon the inclined sides of a centre rail laid between the ordinary rails, thus assisting "the bite or adhesion of the driving wheels of the locomotive." The motion is given to the adhesion wheels by bevil gearing connected with the crank shaft; and the pressure of the wheels on the side of the centre rail (one on one side of the rail, and one on the other side) is regulated by levers that move the bearings of the axles of the adhesion wheels, which levers are under the governance of the engine driver, by means of a handle connected by "pauls," ratchet wheels, and a right and left-handed screw to the levers.

"Self-acting" and "self-regulating indicators," for marking, printing, and recording at the station the times of trains' arrival at, departure from, and passing the said station; also for recording on the engine, whilst passing a station, "the time of departure of a preceding train."

A.D. 1840, December 17.—No. 8743.—Mabley, William Tudor.—Producing surface for "printing, embossing, or impressing," by means of "electro-metallurgy." 1st. The production of a device suitable for printing, &c., such device "constituting one perfect or connected design produced from an originally engraved or otherwise executed portion of the said design," by obtaining as many moulds in relief of the portion of the engraved design as are required to perform the complete design, placing them properly together so as to form the complete design, and electrotyping an entire plate therefrom fit for printing. Flanges, for joining the moulds together, may be obtained on the moulds by fixing bars on the original design and depositing partly on them. 2nd. A mode of joining together printing plates, by electro-depositing metal in grooves formed at the edges intended to be united, the plates being in contact. 3rd. A method of "obtaining an extended surface to an engraved plate" by taking a mould of it, "attached thereto, as described above, a plain metallic or other surface," and then electrotyping the whole. 4th. A method "of producing suitable surfaces as aforesaid," by taking "a flat metal surface," coating it with wax or other easily removeable composition, tracing the design thereon, removing those portions thereof down to the metallic plate that are required to print, rubbing over this a conductor of electricity, and electro-precipitating metal thereon. The application of this method to a cylinder is also given, and plans are described in which a lithographic or other stone or soft metal is used to form the design upon. 5th. The removing from moulds of plates or blocks portions of the design thereon, in order to produce plates or blocks suitable for printing in various colours. Electrotype copies are obtained from the moulds, so that each copy contains only a portion of the design to be printed in one colour. 6th. Dies for embossing horn buttons. Electrotype copies of an original mould or die are taken, and mounted in blocks for use; various ways of mounting them are described, and a method of electrotyping die blocks from a mounted block, from wax moulds, and from buttons themselves. 7th. Various modes of mounting seals, bookbinders' tools, &c., by causing the electrotype to attach itself to the holder "in the act of depositing." 8th. Setting up moulds of portions of seals and producing perfect seals from them by electro-deposition. Various applications relating to initials, &c., are described.

PHOTOGRAPHY AND MAGNESIUM.—To Mr. Brothers of Manchester clearly belongs the credit of being the first to apply the magnesium light to photograghy, and above all, to turn the application to practical account. We observe that he advertises this week in the *Manchester Guardian*, that he has now "completed arrangements for taking portraits and copies by means of the magnesium light, *in all weathers*," and that there is "an exhibition of specimens at his rooms in St. Ann's Square." The advertisement is noteworthy as a precursor of a new development in photographic art. In an article on photography in the current *Quarterly Review*, the writer thus expatiates on some of the advantages incident to the new light:—"The new magnesium light promises to dispense with the necessity of a glass studio, with all its discomfort for the sitter, and all the temptations to meretricious decoration which it appears to hold out to the photographer. The metal magnesium, the oxide and carbonate of which is a familiar medicine, is itself rare. It will burn like a candle, and it emits a light peculiar for its wonderful riches in chemical rays; but, until recently, the cost of isolating it has been so great, that its capabilities have never advanced beyond the rank of a chemical curiosity. Recent discoveries have, however, facilitated its manufacture, and it has come into partial use among photographers. A negative of Sir Charles Lyell was taken with it at the recent meeting of the British Association. A slight further reduction in cost will enable photographers to use it for the purpose of taking likenesses in the houses of their sitters; and the sitters' gain in personal comfort will be duly registered in the improved expression of the picture."

PREVENTION OF DECAY AND OXIDATION IN SHIPS.*

As the prevention of decay in the timbers of wooden-built ships, and the fouling and oxidation of the plates of iron ships, have received considerable attention from the Admiralty and merchant shipowners, the following *resumé* of all the specifications at the Patent Office bearing on this subject is given :—

Dipping timber in boiled oil is a very ancient practice, and it would be difficult to trace its origin. In 1739 Alexander Emerton took out the first recorded patent for preserving wood from decay. He prepared the planks or boards with boiling oil in the then old way, and afterwards coated them with compounded poisons, powdered glass, and sand, cemented with painting colours and oils, laid on as paint. The next patent, which was for preserving copper, or plates of which copper is a basis, was granted in 1790, to Collins & Wyatt. They covered the plates with lead or tin. In the earlier part of the present century several chemists recommended decoctions, in the form of vegetable poisons, for saturating timber, and thus destroying all animal life in the green wood. None of these poisonous solutions seem to have succeeded, for, had they been found efficacious, their application would have been continued. There was then an interval, during which the stoppage of decay seems to have been abandoned, and dry rot allowed to take its course. In 1822, John Oxford secured a patent, whereby he undertook to prevent oxidation or decay in iron or wood, by preparing tar in such a manner as to stop the evaporation of the oil contained therein, saturating it also with chlorine gas. This purified oil is then mixed with 100 parts of white lead—or of red oxide—25 parts of carbonate of lime, and 25 parts of purified coal tar added to the oil of tar. These ingredients are then applied as a paint. In the first days of iron in ship-building, rust was found to be a drawback to its general introduction. Scientific men saw the disadvantage, and sought to remedy the defect. Galvanic action, it was considered, would set all right, and the earliest patent in this direction was taken out by G. G. Bompass, in 1830. He sought to preserve metals from corrosion by an electric or galvanic process For copper to be protected in sea-water he attaches an alloy of 9 to 10 parts of zinc with 100 parts of copper. In protecting iron he employed an alloy of tin consisting of from 10 to 150 parts of tin combined with one of zinc. Following in the footsteps of Mr. Bompass, in the same year, Mr. John Revere patented an invention for fixing zinc protectors to the brace or stud of chain cables, and other iron surfaces exposed to the action of salt water. These galvanic zinc protectors were riveted or soldered on according to requirement. It is known that one of the most distinguished of our electricians is in favour of inserting strips of zinc in the plates of ships; but if this principle proved correct in practice, it would long since have been universally adopted. Zinc plays an important part in patents for the prevention of oxidation. In 1837 Jacob Perkins got protection for a plan of coating copper tubes of boilers with a preparation consisting of two-thirds of zinc with one-third of copper; but he had been preceded in 1832 by Captain H. W. Craufurd, R.N., who proposed to preserve copper and iron from oxidation by coating with zinc paint in a fused state. Over this he laid a second covering of pure tin, or tin alloyed with lead. Captain Craufurd explains in detail his method of compounding the ingredients. In 1838, Le Comte de Fontainemoreau, considering Captain Craufurd's mode of fixing or adapting the zinc to this purpose as erroneous, applied for a patent of a more comprehensive description, for applying the zinc coating to metals. Again, in 1839, Mr. Thomas Dowling patented what he terms a conservative bath, applied to metals after grinding. He describes the machinery by which he effects this, the chief of which is a zinc wheel and galvanic vapour furnace.

In 1840, Mr. J. R. Neilson came forward with his invention for the application of a coating of copper, or copper alloyed with zinc or tin, or both, to the surface of iron. This was done by covering the mould to be cast with the material. In malleable iron, dried borax or flux is spread over the iron, which is then prepared with alloy heated to a temperature sufficient to melt copper, and, in its heated state, plunged into cold water to detach the scale of oxide. Mr Arthur Wall likewise, in 1840, mixed 20 pounds of the strongest muriatic acid diluted with three gallons of water, then added 12 pounds of steel or wrought iron filings. The filings were heated to redness before mixture. The whole was then subjected to heating in a pan, &c., and the composition was then applied to prevent corrosion. In 1841, Mr. W. E. Newton employed silicates of potash, or soda, for making a plaster or coating to prevent iron from becoming rusty. After him came Professor R. Mallet, engineer, of Dublin, whose varied processes are of the most complex character. Finding that iron covered with zinc, when immersed in sea-water, and certain fresh waters, gathered to itself a coating of carbonate of lime, destructive to the protective power of the zinc, and affording a surface for the attachment and growth of marine animals of the molluscous and testaceous classes, and aquatic plants, he applied chemical means to detach the scales of oxide from iron, and then plunged it into a preparing bath. After undergoing a series of processes, the metal is coated with an alloy or zoofagous paint, which paint is rendered poisonous by admixture of salts of metals, by means of which he sought to render the zinc effective as an anti-corrosive protector. In 1841, also, Mr. E. Morewood endeavoured to preserve iron from oxidation or rust by tinning it, and then dipping the tin covering or surface in molten zinc. Moses Poole, in 1845, claimed to possess an invention whereby he rendered iron more hard and durable, and free from oxidation, by the use of ferrocyanide of sodium, calcium, barium, or any other alkali, or alkaline earthy base; to be used in a manner fully set forth in his specification. In 1846, Mr. Andrew Smith improved upon the plans for melting the zinc. He employed a bath of lead or tin, or any composition or medium that melts at a lower degree of heat than zinc, by which means the heat from the fire of the furnace is taken up and transmitted to the receptacle containing the zinc for melting. Baron Wetterstedt, in 1846, added the regulus of antimony to lead sheets, combined copper with antimony, made sheet metal by using lead and tin, and lastly, protected metals by paints thus prepared :—1st. One part of regulus of antimony to three parts of copper, mixed, melted together, run out into water, and then heated gently. Two parts of oxide of copper are added, and moistened with naphtha. The whole is then added to a composition of tar and naphtha. 2nd. Another paint is compounded of 30 lbs. of tar, 30 lbs. of pitch, 20 lbs. of dried soot, 4 lbs. of tallow from sperm oil, and naphtha added for consistency.

Mr. C. H. Paris, in 1849, coated metals with glass or vitreous matter. The metal went through a cleansing process. Gum water is then applied, and over this the dry or powdered glass is shaken, and then fused by heat till a glass surface is formed. Mr. Paris claimed the application of carbonate of soda for applying glass in this manner. Mr. J. MacIntosh, in 1852, made a paint from decomposed india-rubber in combination with oils or fatty matter, saponified by metallic salts, with lime for thickening the liquid. For bottoms of ships he recommends the india-rubber, when in a fluid state, to be combined with metallic soap, thickened with lime and coloured by pigments. Messrs. Hughes and Firmin, in 1852, manufactured lamp black from the vapour of coal tar, dead oil, dead oil salts, coal pitch, naphtha, linseed oil, and other materials. From the products a fuel is produced, and this residue has by another inventor been mixed with oils, ground and made into a paint. In 1852, also, Mr. R. M. Glover took out a patent for a preparation of arsenite of lead and arsenite of copper, and the red and yellow sulphurets of arsenic. The proportion of each were as follows :—Two parts, by weight, of arsenite of lead, one of realgar, one of orpiment, and one of arsenite of copper. In the same year, Mr. J. Murdock invented a variety of driers for zinc when the white of zinc is employed instead of white lead. The protoxides are manganese, cobalt, iron, tin, and nickel; for acids, the benzoic, urobenzoic, and the boric. In 1852, Mr. Binks patented a substitute for linseed or drying oils, in the products derived from dissolving what are called insoluble soaps. A pigment is then ground in this solution, and the paint is ready for application, The pigment may be white lead, oxide of zinc, lamp black, or any other. J. C. Medeiros, in 1853, proposed the use of mercury or quicksilver on iron plates for sheathing ships. The salts of mercury are dissolved, then a bath is formed, and the plates allowed to remain in the solution till their surface is equally and regularly amalgamated.

Mr. Newton, in 1854, made a paint from ground plumbago, pulverized charcoal, and the black soot formed by the burning of bituminous matter, along with ivory black, or bone or lamp black. Mr. Ryder also, in 1854, described a method for mixing gutta-percha with common resin, or tar, pitch, or asphaltum, dissolving them in impure benzole or coal naphtha. Mr. Newton took out a second patent, in 1854, for the production of a siccative black, brown, or grey pigment or colouring matter, by the admixture with the gas tar, or other organic substance to be carbonized for the purpose, of the oxides of potassium, sodium, calcium, aluminum, or other alkaline or earthy bases for paints. Mr. F. Ransome, 1854, patented a mixture, consisting of ground oxides and carbonates

* From the Journal of the Society of Arts.

of lead or zinc, and carbonate or sulphate of barytes with soluble silica. Mr. J. Rogers, in 1855, to prevent oxidation, deoxidizes metallic ores by a revolving cylinder, fitted with helical or screw-formed divisions to receive the ores in a pulverized state, and then submits the same to heat, and constant agitation by the revolution of the cylinder. Mr. B. Rosenburg, in 1855, manufactured a paint as follows:—100 lbs. of triturated white lead, 2¼ gallons of copal varnish, 1½ gallons of spirits of turpentine, 1½ gallons of linseed oil, and, for colouring, a small quantity of red lead. Before the metal is painted it is subjected to the fire for cleansing, and when cool the preparation is applied, then varnished with copal, and dried by a hot air process. Mr. J. E. Cook, in 1855, proposed a composition consisting of gum shellac, dissolved in methylated spirit or in wood spirit. In 1856, the patent of Messrs. Bancroft & White claims the manufacture of oils from petroleum, for preserving metals and ships' sheathing. Mr. A. F. Mennons, in 1856, obtained a patent for a non-conducting and inoxidable composition for metals, made thus:—

Argillaceous clays, containing a certain proportion of alumina	100 parts.
Oily substances and residues	6 "
Oil sediment	5 "
Fat	2 "
Animal charcoal	2 "
Mucilaginous substances, such as glue, &c.	2 "
Wood sawdust, already employed in the purification of oils in the process of dyeing	10 "
Waste hair well beaten	4 "

To the preceding materials a decoction of logwood and soot is added.

Mr. J. M'Innes, in 1856, was granted a patent for coating metals with powdered emery stone mixed with a varnish of shellac dissolved in spirits of wine, with the addition of castor oil. As emery contains 87 per cent. of aluminium, Mr. M'Innes considered that this paint would be solid enough to resist all action in the water, and never decompose. Mr. R. D. Atkinson, of Hull, in 1856, invented a plan for coating and protecting metals from oxidation, by depositing copper or brass upon surfaces of prepared iron, the deposit to be melted in conjunction with carbonic acid gas, the coating to be put on by a brush, or through the medium of galvanism. Depositing brass on iron is now being successfully carried out at Portsmouth, by Mr. Wielan, on armour plates and other iron surfaces. Mr. A. Reid, mineralogist, in 1856, describes in his specification what he deems a sure way of preventing oxidation. He places the iron in a properly constructed furnace, then covers the metal with soot, or other matters possessing the like element, the temperature is then raised to red or white heat, and continued for half an hour, or according to the size of the iron operated upon. It is then suffered to cool, the surface is cleaned, and Mr Reid asserts that a coat impervious to rust is formed. If this is verified by positive experiments, the cheapness and simplicity of the plan deserves to be widely known. Mr. Joseph Poleux, of New York, communicates, in the same year, a plan to overcome oxidation. He employs muriatic acid, nitric, or sulphine acid, of the ordinary degrees of concentration in commerce, without dilution combined with the introduction of spelter into the cleansing process. In 1857, Mr. G. Bedson patented a new process He melts a quantity of pitch derived from mineral tar, and a proportion of tar oil, with caoutchouc tempered with tar oil and shellac, the substance to be solid and elastic when cold. Mr. C. F. L. Oudry claims depositing copper on a preservative or intermediate coating instead of on the metal. He deposits copper in a pure state to any thickness on all metals. Mr. C Iles, in 1857, describes a means of applying earthy cements to metals. In 1858, Mr. J. Coutts received a patent for applying the following pigment by heated air:—

Carbonate of baryta	·650
Litharge	·065
Arsenious acid	·030
Asphaltum	·050
Oxide of calcium	·030
Creosote (oil of tar)	·175

Perhaps the most novel introduction is that patented here by Messrs. Bouchard & Clavel, the Paris bankers, in 1858. On the estate of La Gruerié, in Charney, Department of Yonne, France, is found an earth of the ochre description, called "Burgundy Red." This earth contains most valuable properties, and is said to be an exceedingly good preservative against rust. It is used as a cement and paint by admixture with the following:—

Burgundy red	66 parts.
Grease of oil	15 "
Lime	11 "
Unburnt earthenware, chalk, or Roman cement	8 "
	100 "

This is said to prevent oxidation if the earth is merely diluted with volatile oil. D M'Crae, in 1858, was allowed a patent for preserving bottoms of ships from fouling or decay. He applies grease from the cells of boiled bones, kitchen-stuff, and butter without salt; a poisonous matter is mixed with these fatty substances. Mr G. P. Lock, in 1858, made a composition for the under coating of iron ships, made from iron ore ground in boiled linseed oil 50 per cent., oil of turpentine 50 per cent., well mixed. For the outer coatings, white lead 40 per cent., blue mineral or copperas 10 per cent., and oil of turpentine 50 per cent. In 1859, Mr. Henry, on the part of Moisant & Co., sought protection for bituminous products and compounds of bitumen for preventing oxidation. Mr. T. J. Labelle made a preparation of caoutchouc paints and colours for vulcanizing. Mr. J. Crawford, of Liverpool, in 1859, applied for a patent for a metallic paint or varnish, composed of plumbago, or black lead, fine or gum varnish, arsenic, and spirits of turpentine mixed. Mr. F. W. Emerson, in 1859, prepared an anti-corrosive paint from oxi-chloride of lead, mixed and ground with oil, turpentine, varnish, or other vehicle. Mr. Weild, in 1859, sought to economise time and labour, by a mechanical machine for applying paints to metals on large surfaces. Mr. James Meikle, in 1859, proposed coating iron ships with asphalte, In the same year M. Auguste Pin dissolved sugar in muriate of zinc, then added wax and soap, in which was incorporated calcareous stones, phosphate of soda, sulphate of zinc, and copper, and the syrup of potatoes or sugar, with powdered marble, quartz, or felspar.

In 1859, Mr. F. G. Spilsbury, of Louvain, applied for a patent for the manufacture of a paint. He took sulphate of lead, and heated it to a red heat, either by itself or mixed with alumina or other earths; the pigment thus obtained to be washed first with sulphuric acid, then with water, when it is finally dried. Previous to drying the pigments are digested with salts of tungstic acid, molybdic acid, titanic acid, tantalic acid, arsenic acid, acid of antimony, or other metallic acid, or with mixture of the above salts. A combination between the sulphate of lead and the metallic acid or acids is obtained, and the resulting pigments are dried in like manner after having been cleared from all adhering salts. The pigments may then be mixed with oil and used as a substitute for white lead. Mr. J F. J. Lecocq, in 1860, prepared a calcareous varnish for coating iron and the bottoms of ships. Mr. H. Kemp, in 1860, patented a composition consisting of peat tar, wood tar, methylated spirit, peat oil, or linseed oil, arsenic, resin, and carburet of iron, for preserving ships' bottoms. Mr. Allen's plan for making a coating or anti-corrosive paint for metals is thus given:—Ammoniacal liquid obtained from coal tar, or gas tar, prevents incrustation in boilers, and is applicable to painting the inside plates. Messrs. Pile & Smyth, of West Hartlepool, took out a patent in 1860. They employ a red composition and enamel, consisting of a combination of litharge, Venetian red, and pine varnish. Over this composition is applied a coating of resin, gums, or any pitch or bituminous substance, with the addition of coal tar or oil This is put on in a hot lava state, and the process is called enameling. An impermeable oil varnish was patented by M. Antoine Bonet, in 1860, composed of 100 parts of alcohol, 100 parts of spirits of turpentine, one part of sulphuric ether, and one of carbonate of soda.

Mr. Robert Smith, shipowner, of Finsbury, applied to the Patent Office, in 1860, to protect his system for keeping vessels from fouling and worming. He applies equal parts of pitch, tar, resin, and turpentine, with any other adhesive compound. Assafœtida to be mixed with the foregoing, as a poison to destroy life. When the coating is laid on, and dry, the whole to be covered with paper or cloth. Mr. G. Hallet, in 1860, in his patent explains his method of protecting metal. He grinds the oxide of antimony to powder, then dries it, and mixes with it 12 lbs. of linseed oil to the hundredweight of powdered oxide. Mr. Richardson, in 1861, to prevent oxidation, would cover the metal with vulcanized india-rubber, cloth, or gutta-percha, the object sought being to provide for unequal expansion of the metal and coating. Mr. Francis Pulz, chemist, 1861, causes oxygen to be passed through sulphuric acid, to render the oxygen more active as an oxidizing agent, as it combines, when so treated, with other substances for which it has an affinity, for manufacturing purposes. Mr. Pulz also, in a second patent, submits oily matters to this oxidizing agency, by causing the sulphureted gas to pass through them when in a liquid state. Mr. Martin Miller sends a communication, in 1861, for coating metals by metals or alloys in different ways. Mr. John Hay, in 1861, patented a drying oil. He lays a non-conducting coat, and then makes a paint by grinding in linseed oil the black or protoxide

of copper, which is then boiled till reduced to the sub-oxide, and by thus oxygenating the oil he claims to have formed a quick drying cupreous oil. Mr. John Snider, of the United States, patented here a compound, in 1861, for coating metals. He reduces amorphous graphite to fine powder, and then mixes it with ore by the agency of a heated steam-pipe. When cool and dry, one pound of oil is added to three pounds of the powder, and when the ingredients are combined, hot pure bees'-wax, in the proportion of one pound of wax to ten pounds of graphite, is mixed. Afterwards linseed oil may be added. Mr. Snider details his manner of manipulating and preparing the graphite and ore. Messrs. Hallet and Stenhouse, in 1861, obtained a patent for the manufacture of pigments for coating surfaces. They employ native oxide of antimony, chemically treated in ways too intricate for explanation in this abbreviated outline, and mixed with red lead or litharge. They sometimes take type metal or worn-out types, reduce them to a coarse powder, and then mix them with their own weight of zinc, and calcine them. This produces a yellow pigment.

INDIAN TELEGRAPHS.

The following letter, addressed by the Secretary of the Kurrachee Chamber of Commerce to the Secretary to Government at Bombay, in answer to a communication from the latter official inquiry whether the working of the telegraph had improved during the past twelve months, has been published by the Committee of the Kurrachee Chamber of Commerce :—

Chamber of Commerce, Kurrachee, May 17, 1864.

Sir,—I have the honour to acknowledge the receipt of your letter, No. 846, of 1864, requesting the opinion of the Chamber of Commerce as to whether "the working of the telegraph department has, during the last twelve months, improved."

Previous to the receipt of your letter under reply, it had been resolved by the managing committee of the Chamber to memorialize the Governor-General in Council upon the present disgraceful state of the telegraph line between Kurrachee and Bombay, and its almost total inefficiency for commercial purposes. This fact will show you that no improvement has taken place, and in the opinion of the Chamber the line is at present, so far as can be judged by results, in a worse state than before. Interruptions are not, perhaps, more frequent, but the time occupied in transit is generally so long, and always so uncertain, that the advantages usually derivable from telegraphic communication are quite neutralized. It is impossible to calculate with any approach to certainty how long it may take to send a message to Bombay, or within what time an answer may be expected. As a case in point, I may mention that telegrams of the 6th and 9th instants were received here on the 10th, and of the 7th and 9th on the following day, and irregularities of this kind are of constant occurrence. In addition to this, commercial messages are frequently so mangled as to be not only perfectly useless, but liable to cause serious loss and inconvenience by misleading the recipients on matters of mercantile importance. So gross are these mistakes, that it is hardly safe to embark in any commercial transaction upon the faith of telegrams received from Bombay, and instances could be named in which merchants here have been subjected to pecuniary loss by making their calculations upon quotations contained in Bombay telegrams.

In the opinion of the Chamber of Commerce most, if not all, of these evils are caused by the single line of wire between Kurrachee and Bombay being totally insufficient for the work it is required to perform ; and this evil they believe to be aggravated by the system of centralization under which the department is managed, and which, as they are informed, involves a reference to Calcutta, and consequent delay, before undertaking the most simple necessary repairs. In order to maintain efficient communication with Bombay, a double line or submarine cable is absolutely essential, and it is believed that even this will not meet the object in view without a thorough reorganization of the department, involving an abolition of the centralization system, a much more liberal scale of expenditure for maintenance and establishments, and a transference of the superintendence of the lines from a distant official in Calcutta to the local Governments, and to well paid and responsible subordinates.

The Chamber desire especially to draw the attention of the Government of Bombay to the fact that telegraphic communication with England, viâ the Euphrates valley, is now nearly established, and that as soon as this line is completed, messages of the utmost importance may be expected to arrive daily in Kurrachee. The line from this place to Bombay is even now overburdened, and all but useless, and the Chamber leave you to imagine what the result will be when a vast mass of official and private telegrams of English news require to be transmitted in addition to the existing traffic.—

I have, &c., (Signed) H. Jacob, Secretary.

A. D. Robertson, Esq., Secretary to Government, Bombay.

Telegraph Clerks' Provident Fund.—The Most Noble the Marquis of Townshend has, we understand, consented to become the president of this promising institution.

GALVANIZING IRON.

The processes of galvanizing iron (in sheet and in wire) are but little understood. In order, therefore, to disseminate useful information on this subject, we herewith append an account of the various operations necessary to be performed to effect the coating of iron with zinc, for which we are indebted to the supplement of "Ure's Dictionary of the Arts and Sciences":—

In 1837, Mr. H. W. Crawford patented a process for zincing iron. In the "Repertory of Patent Inventions," his process is thus described :—Sheet-iron, iron castings, and various other objects in iron, are cleaned and scoured by immersion in a bath of water acidulated with sulphuric acid, heated in a leaden vessel, or used cold in one of wood, just to remove the oxide. They are then thrown into cold water, and taken out one at a time to be scoured with sand and water with a piece of cork, or more usually with a piece of the husk of the cocoa-nut, the ends of the fibres of which serve as a brush, and the plates are afterwards thrown into cold water.

Pure zinc, covered with a thick layer of sal ammoniac, is then melted in a bath, and the iron, if in sheets, is dipped several sheets at a time in a cradle or grating. The sheets are slowly raised to allow the superfluous zinc to drain off, and are thrown whilst hot into cold water, on removal from which they only require to be wiped dry.

Thick pieces are heated, before immersion, in a reverberatory furnace, to avoid cooling the zinc. Chains are similarly treated, and on removal from the zinc require to be shaken until cold, to avoid the links being soldered together. Nails and small articles are dipped in muriatic acid and dried in a reverberatory furnace, and then thrown all together in the zinc, covered with the sal ammoniac, left for one minute, and taken out slowly with an iron skimmer. They come out in a mass, soldered together, and for their separation are afterwards placed in a crucible and surrounded with charcoal powder, then heated to redness and shaken about until cold, for their separation. Wire is reeled through the zinc, into which it is compelled to dip by a fork or other contrivance. It will be understood that the zinc is melted with a thick coat of sal ammoniac to prevent the loss of zinc by oxidation.

Mr. Mallett coated iron with zinc by the following process :—The plates are immersed in a cleansing bath of equal parts of sulphuric or muriatic acid and water, used warm ; the works are then hammered and scrubbed with emery and sand to detach the scales, and to thoroughly clean them ; they are then immersed in a "preparing bath" of equal parts of saturated solutions of muriate of zinc and sal ammoniac, from which the works are transferred to a fluid metallic bath, consisting of 202 parts of mercury and 1,292 parts of zinc, both by weight, to every ton weight of which alloy is added above one pound of either potassium or sodium, the latter being preferred. As soon as the cleaned iron works have attained the melting heat of the triple alloy, they are removed, having become thoroughly coated with zinc. At the proper fusing temperature of this alloy, which is about 680° Fahr., it will dissolve a plate of wrought-iron of an eighth of an inch thick in a few seconds.

Morewood and Rogers's galvanized tinned iron is prepared under several patents. Their process is as follows :—The sheets are pickled, scoured, and cleaned, just the same as for ordinary tinning. A large wooden bath is then half filled with a dilute solution of muriate of tin, prepared by dissolving metallic tin by concentrated muriatic acid, which requires a period of two or three days. Two quarts of the saturated solution are added to 300 or 400 gallons of the water contained in the bath. Over the bottom of the bath is first spread a thin layer of finely-granulated zinc, then a cleaned iron plate, and so on, a layer of granulated zinc and a cleaned iron plate alternately, until the bath is full. The zinc and iron, together with the fluid, constitute a weak galvanic battery, and the tin is deposited from the solution so as to coat the iron with a dull uniform layer of metallic tin in about two hours. The tinned iron is then passed through a bath containing fluid zinc, covered with sal ammoniac mixed with earthy matter, to lessen the volatillization of the sal ammoniac, which becomes as fluid as treacle. Two iron rollers immersed below the surface of the zinc, are fixed to the bath, and are driven by machinery to carry the plates through the fluid metal at any velocity previously determined. The plates are received one by one from the tinning bath, drained for a short time, and passed at once, whilst still wet, by means of the rollers, through the bath, as described. The plates take up a very regular and smooth layer of zinc, which, owing to the presence of the the tin beneath, assumes its natural crystalline character, giving the plates an appearance resembling that known as the *moirec metallique*.

It is stated that galvanized iron plates, cut with shears so as to expose the central iron, become zinced round the edges, and at the holes where the nails were driven. We are also informed that *ungalvanized iron* will, if moist when near galvanized plate, become zinced, and that telegraph wires, where cut through, become coated by the action of the rain water on the galvanized portion of the surfaces.

It has been stated that the galvanized iron is not more durable than unprotected iron ; that, indeed, where the zinc is by any accident removed, the destruction is more rapid than ordinary. We have made especial inquiries, and find that in forges where there is any escape of sulphur vapour the galvanized iron does not stand well, but that under all ordinary circumstances it has the merit of great durability in addition to its other good qualities.

TELEGRAPHIC NEWS.

THE TELEGRAPH IN RUSSIA.—Intelligence has just been received of the opening of the telegraph line from Irkutsk to Kiachta. News may now be sent to Pekin in four days' less time than formerly by the ordinary post.

TELEGRAPHIC PROGRESS ON THE CONTINENT.—The Austro-Germanic Telegraphic Union included on the 1st January, 1864, 981 stations, distributed over an extent of 5,205 geographical miles. This is an increase of 226 stations and 710 miles of telegraphic line over 1863.

THOMPSON'S ELECTRO-MAGNETIC INDUCTION MACHINE.—We have on several occasions adverted to Mr. Thompson's valuable invention for obtaining currents of electricity of any required electro-motive force from a battery of small electro-motive power. The advantages of this machine have been recognised by the eminent electro-plating firm of Elkington, Birmingham, who are, we believe, about to introduce it into their manufacturing establishment. The electro-magnetic induction machine is applicable to a variety of purposes, for particulars of which we refer our readers to another part of this journal.

THE TELEGRAPH FROM RED RIVER TO NEW WESTMINSTER.—Notice has been given in the British Columbian *Gazette*, that Dr. Rae was expected in that colony by way of the Rocky Mountains, completing his survey of the proposed line of telegraph, and that the Governor requested all magistrates and other public officers to furnish him with such aid and assistance as he might require. Accounts from the mine districts state that Dr. Rae has arrived at the mouth of the Quesnelle, having come down the Frazer from Fort George in a canoe with one Indian.

THE CYCLONE AT CALCUTTA.—Mr. C. B. Ransom, master of the ship Sophia Joakim, writing from Calcutta on the 6th ult., says:—"All the telegraph wires are deranged, so that we have no information of the effects of the storm on vessels at the Sandheads; but as the centre of the cyclone passed to the southward of Calcutta, we fear that the hurricane was felt severely at the Sandheads and at the head of the Bay of Bengal." The agents for Lloyd's, at Calcutta, under the same date as the foregoing letter, write:—"The telegraph wires have been destroyed, and since the occurrence of the tempest there has been no communication with any of the river stations."

LOSS AND RECOVERY OF £1,000.—On Monday last, while a merchant was passing along the passage leading from the Exchange to St. Vincent-place, Glasgow, he dropped a parcel containing £1,000—ten £100 notes of the Union Bank. Immediately thereafter a lad named Cunningham, a clerk in the Magnetic Telegraph Company's office, found the notes at the foot of the stairs leading to the superintendent's department, and at once handed them to his superior, who, on discovering that the notes belonged to the Union Bank, proceeded hither, and handed them over to the secretary. In a short time afterwards the merchant entered the bank to make known his loss, but was gratified to receive his cash. On hearing who the finder was, he proceeded to the telegraph office, and presented the lad Cunningham with £100.

THE INDO-EUROPEAN TELEGRAPH.—The *Bombay Gazette* of the 14th October contains the following:—A telegram, dated 27th September, has been received by the Governor of Bombay from Major Champain, director of the Persian telegraph, from Teheran, which occupied only 16 hours and 21 minutes in its transmission from the Persian capital to Dapooree, announcing the completion of the telegraph from Bushire to Teheran. The line to Bagdad would, it was expected, be completed in ten days from the above date; but it cannot be worked until the dispute between the Turks and Persians regarding the frontier has been settled. Messages can now be sent from Bushire to Shiraz, Ispahan, and Teheran, and to all parts of India by the submarine telegraph through Kurrachee. Communication between Kurrachee and Bussorah is now perfect—from Kurrachee to Gwadur by aerial telegraph, and thence to Fao by submarine cable. The two breaks in the cable between Kurrachee and Gwadur will be shortly repaired.

GREAT INUNDATION IN ITALY.—By a telegram from Turin, dated the 9th November, we learn that serious damage has been caused in Tuscany by heavy rains. The floods have broken up the railway lines at several points, thereby destroying the communication between Empoli, Siena, Macchia, and Pistoja. Between the latter place and Bologna, the Arno has burst its embankment, overthrown the telegraph poles, and swept away the works which were in course of construction. The latest despatches state that the lower parts of Florence are inundated, and that the Arno has risen to the level of the parapets of the quays. The above news, despatched from Florence on the 6th inst., only reached Turin to-day, in consequence of the interruption of the telegraphic communication. News of a more satisfactory character has been received this afternoon.

ATLANTIC TELEGRAPH CABLE.—We are given to understand that the manufacture of this cable is proceeding very rapidly. One of the Government tugs, acting as tender to the Great Eastern, lies off Morden Wharf ready to receive on board 300 miles now completely sheathed and ready for coiling in the tanks which have been fitted in the hold of the great ship for the purpose. Some experiments have recently been made to test the strength and ductility of the cable, the results of which are of a very satisfactory nature. A given length was taken, suspended, and gradually weighted until it broke, the elongations succeeding each additional weighting being duly registered. The cable selected bore the weight of six three-fifth tons. The case, the spiral wires involving it, the insulating body, the jute yarn, and each separate strand of the cable were similarly tested. It was found from those experiments that the more the fibres of wire were brought into a state of tension, the greater became its strength, and that as an insulator gutta percha, although not so perfect as india-rubber, is far more durable, and that the cable as now manufactured will be able to bear a strain four times its own weight when laid at the bottom of the Atlantic.

THE UNITED KINGDOM ELECTRIC TELEGRAPH COMPANY.—"D. W." writes a contemporary in the following strain:—"We have, as you well know, rival companies of all kinds and descriptions, and of the number are telegraph companies. These latter profess to transmit messages for the public, at certain charges, with all possible speed; and the public cannot be considered unreasonable in expecting that the promises will be faithfully performed, especially as telegraphic messages are most generally of the greatest importance. I regret that I should have found that it will be quite necessary soon to have some legislative measure passed to compel these companies to perform the duties they undertake with greater regularity and certainty than they do at present, as the following case will, I think, clearly prove. I had occasion on Saturday, the 22nd of October, to send a message from Northumberland to Gloucestershire, calling to the bedside of a poor dying clergyman his brother. The message in question (written in the most urgent words that could be employed) was sent to the nearest station of the United Kingdom Electric Telegraph Company, between five and six P.M. It could not be sent just at the time, as other messages were being transmitted; but I shall, I am afraid, hardly be believed when I state that the clerk never forwarded the message at all, notwithstanding its very urgent nature, and gave no notice of his having neglected to send it until the following Monday at noon! The poor sufferer (whose illness came on very suddenly) breathed his last on Sunday afternoon, without having seen his relative; and it has now been found that it was of the greatest importance that the desire of this poor man to see his brother should have been gratified. It was, however, denied to him through the unpardonable (as I think) negligence of the officials of this very badly conducted telegraphic company. Pray allow space, if possible, for this simple statement of facts in your all-powerful journal, in the hope of preventing similar neglect of duty."

TELEGRAPHIC COMMUNICATION WITH BOMBAY.—By letters just received from Teheran we learn that Major Champain, R.E. (the officer employed in the construction of the Persian lines) was on the 29th of September last in direct communication with Bombay by means of the line constructed by himself from Teheran to Bushire, and of the submarine cable laid down by his chief, Lieut.-Col. Stewart, from Bushire to Kurrachee and Bombay, the distance from Teheran to Bushire being 700 miles. The time occupied in transmitting the first message from Teheran to Bombay was less than four hours and a half. Major Champain has also finished the line from Bagdad to Teheran with the exception of about twenty miles, which is the subject of a boundary dispute between the Persian and Turkish authorities, and which, at the date of our advices, he had not been allowed to connect, although the wires were actually within a few feet of each other. However, it was Major Champain's intention to connect the finished portions of the line by horse expresses three or four times a day until the termination of the dispute. In the meantime the recently completed Russian line from St. Petersburg to Teheran (although uncertain and expensive) affords an uninterrupted telegraphic communication between London and Bombay.

TELEGRAPHY IN NEW ZEALAND.—An advertisement which appeared in our [*Colonist*] columns a few days ago, calling for tenders for the supply of 4,000 telegraph poles, to be delivered between Nelson and the southern boundary of the province, passing through the province of Marlborough, is one of those "signs of the times" which are calculated to arrest attention in no ordinary degree. Little more than twenty-two years have elapsed since the first arrival of European settlers in this island, and so rapid has been the progress of the colony, that in all human probability ere the twenty-third year has run its course, the electric telegraph—that marvellous engine which is fast converting the whole of Christendom into one vast whispering-gallery—will be in active operation from Nelson at the north extremity of the island, to Invercargill at the south, and the capitals of all the five provinces—Nelson, Marlborough, Canterbury, Otago, and Southland—will be placed in almost instant communication with each other. Already telegraphic poles have been erected from Southland to the Waitaki; throughout the whole length of the Canterbury province they are either upon the ground, or will speedily be so; and now tenders are invited to furnish the number required for the extension of the line through the provinces of Nelson and Marlborough. As the wire and all the apparatus required for the purpose are either now in the colony or on their way hither from England, the completion of the line may almost certainly be calculated upon within the time we have specified.

EXPLOSION AT THE LIVERPOOL OFFICES OF THE UNITED KINGDOM TELEGRAPH COMPANY.—On the 9th inst., about eleven o'clock in the morning, the frequenters of the "flags" were startled by a loud report, which proceeded from the basement floor of the Liverpool and London Chambers. It was soon ascertained that the cause of the disturbance was an explosion of gas at the office of the United Kingdom Electric Telegraph Company, doing damage to the extent of about £20. From about nine o'clock in the morning the officials employed in the office had noticed a smell of gas. They sent twice to the gas-office in Newington for a man to come down and inspect the meter, but, as no one came, and the gaseous fumes became stronger, a man was obtained from Mr. Holgate's, a gasfitter, in Dale Street. After trying in vain for some time to find out the place of escape, this man

went with a light to examine the meter, which stands in one corner of the front offices. An explosion of considerable violence immediately followed. The glass front of the office was completely blown out, the partitions in the office were torn from their fastenings, and removed several feet from their proper positions, and even the heavy counter was shifted. In fact, in a moment the place had become a scene of disorder. Though of course greatly alarmed, neither the man who had unwittingly caused the accident, nor the clerks in the office, received any bodily hurt beyond a few flesh cuts from the fragments of broken glass, which were sent flying about in all directions. Mr. Barrett, superintendent of the West of England Fire Brigade, who happened to be in the Liverpool and London office, on hearing the explosion immediately ran to see what was the matter. Some smoke which was issuing from the office at first led him to suppose that the fittings had been set on fire, but he soon discovered that the smoke proceeded from a fire in the office, and that, as a matter of precaution, was immediately put out. The gas was then turned off at the meter, and the floor having been taken up, it was found that the gas had escaped from a fracture in the pipe one inch long, probably caused by a nail having been driven in. The gas had made its way through the crevices in the flooring, and being heavier than the air had hung about the ground till its whereabouts was so startlingly announced upon the application of a light. The building belongs to the Liverpool and London Insurance Company, and, of course, is insured in their own office. The telegraph company is uninsured. The working of the telegraph will not be interfered with. Inspector Gardner and fireman 859 were early in attendance, and rendered all the assistance they could. Mr. Andrews, the secretary of the United Kingdom Telegraph Company, informs us that the first report of the disaster was exaggerated.

MISCELLANEA.

Meteor.—M. Beraud, in a letter read at a meeting of the Academy of Sciences, states that on September 24, when he was upon an eminence near Gouzon, not far from Limoges, a little before noon, he perceived a meteor in the direction of the south-west. It had the form of a long, vertical flame, slender at the two ends, descending with a slight inclination to the west. In another letter, M. J. de Lan Lusignan states that at the same time, while in the château of Lan, near Nogaro (Gers), he heard a sound resembling prolonged thunder, the sky being very serene, and without evidence of a storm. He went out immediately, and found several persons examining a little cloud which was passing slowly over the horizon from north to south. Some had perceived a ray resembling lightning. No doubt the thundering in a clear sky remarked on by the ancients was due to meteoric phenomena.

The Great Eastern.—The action against the Great Eastern, which had been some time pending in the Court of Admiralty, has just been brought to a close. It will be remembered that the Court of Admiralty held the Great Eastern to blame for the collision by which the Jane was sunk; but on an appeal to the Privy Council it was reversed, and both parties held to blame. The matter then went before the Registrar of the Admiralty Court, and Mr. Pritchard appeared for the Great Eastern. After hearing the parties, it was held that after deducting the claim put forth by the big ship, the Company should pay £2,000 to the owners of the Jane, and be released, each side to pay their own costs. The money was paid out of £6,000 deposited in court by the Great Ship Company, and the vessel released; and thus the long-pending suit was terminated. It is to be hoped that we have heard the last of the difficulties of the leviathan ship, and that its next voyage will prove a success.

Removal of the Great Exhibition Building.—The operations for the removal of the Great Exhibition building were resumed on Saturday the 5th instant by the Royal Engineers, under Sir J. Burgoyne, Colonel Lovell, Lieut. Knocker, and a corps of sappers and miners from Chatham. The first experiment was directed to the displacement of the great corner tower in the Cromwell-road, on the left of the grand entrance, in height about 50 feet, by 40 feet square, and 150 tons in weight, the explosive charge being from 100 lbs. to 150 lbs. of gunpowder. The fuse having been applied, and the sappers and miners having connected it with the electric wires of the battery some 200 yards away, the word of command was given by the shrill sound of a bugle, but the explosion had no perceptible effect whatever on the enormous structure, beyond making a breach in the bricks at the basement, and causing a cloud of smoke dust. A second and a third time supplemental charges of ammunition were applied, and the bugle sounded and the battery fired, but with the same result as before; the tower stood stubbornly, and it was thereupon determined to abandon that part of the experiment, and to operate on the Albert towers at the western end of the building, to which the spectators flocked. Here the apparatus of destruction was again arranged, and the bugle sounded, but no successful result was achieved until the second sound of the bugle, when suddenly one-half of the first tower came down with a tremendous crash to the ground, amid the cheers of the spectators. Attempts were made to dislodge the other half of the tower, but, as it was getting dusk and dangerous, further operations were deferred. Two causes are assigned for the failure that took place; first, the incompleteness of the electric connection with the explosive charges; and, secondly, to the explosive powers not being equivalent to the mass to be removed.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2710. R. C. Robinson, improvements in semaphoric signals applicable to railway carriages.

2712. F. J. Scott, improvements in means or apparatus for signalling between passengers and guards, or others, in railway trains.

2713. J. Walker, an improved method of making signals in carriages, particularly applicable for communicating between passengers and guards in railway trains.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2280. J. Adams, improvements in the means of communicating or signalling between the different parts of railway trains.

2486. C. H. Collette, improvements in magneto-electric machines.—A communication.

PATENT WHICH HAS BECOME VOID.

2661. T. Morris, R. Weare, and E. H. C. Monckton, improvements in magnets, induction coils, and in insulating wire and metal for electric and other purposes.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	2/ to 2/3	per lb.

India Rubber.

Para, first quality	1/7 to 1/8	,,
second ,, ...	1/4 to 1/5	,,
third Negro-head	1/1 to 1/2	,,
Java and Penang	1/2 to 1/4	,,

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	104 to 107	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	8	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co.,	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{3}{4}$ to $\frac{1}{4}$ dis.	—

TO CORRESPONDENTS.

J. Henderson.—There need be no apprehensions of danger in the burning of magnesium wire, which will, doubtless, illuminate many a drawing-room during the ensuing Christmas festivities.

John Edmonds.—A very excellent lacquer for your purpose may be made as follows:—Alcohol, 80 ozs.; gum gutta, 8 ozs.; gum sandarac, 8 ozs.; dragon's blood, 4 ozs.; seed lac, 4 ozs.; terra merita, 3 ozs.; saffron, 8 grs.; pulverized glass, 12 ozs. Apply in the usual manner.

Failure.—The oxidation of the iron wire coating of telegraphic cables takes place at a temperature above 50°, but only when air and moisture have free access to the surface of the metal.

S. P.—La Place says, "that between the heavenly bodies all attractions are transmitted with a velocity, which, if it be not infinite, surpasses several thousand times the velocity of light."

⁂ We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street, E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co., Manchester; at the various railway stations; and of all news-agents, &c. &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

Quarterly, 4*s.* 4*d.* | Half-yearly, 8*s.* 8*d.* | Yearly, 17*s.* 4*d.*

TO ADVERTISERS.

Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

	£. s. d.		£. s. d.
Whole page	4 4 0	Quarter page	1 7 6
Half ditto	2 10 0	Four lines and under (single col.)	0 3 6

Single Advertisements from the country must be accompanied with stamps in payment.

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ON RAILWAY ELECTRIC SIGNALLING.

By W. H. Preece, Assoc. Inst. C.E.

(*Continued from page* 219.)

In establishing electrical signalling upon the London and South Western Railway, great precautions have been taken to eliminate every imperfection in existing instruments and to make the plan fully meet every requirement demanded of such a system. These requirements are :—

1st. A means of communication between two stations which shall give notice of the approach and departure of trains.

2nd. A "Danger" and "All clear" signal to rule and protect each line of rails.

3rd. That the man at one station shall have the sole and complete control over the signal at the other station, and that it shall be *impossible* for him to interfere with or alter the signal in his own box.

4th. That every signal shall be properly acknowledged, and that the acknowledgment shall not only imply the due receipt of the signal sent, but that it has been correctly understood and properly acted upon.

5th. That any derangement of the apparatus or the accidental delivery of a false signal, either by the man himself or by the mechanical interruptions to which the wires are liable, shall at once indicate danger and produce safety.

The main principle embodied in the above requirements is that the electric signalling shall be assimilated as nearly as possible to the out-door signalling, and that careful repetition and unmistakeable acknowledgment of everything done shall compensate for the loss of visual inspection and ocular supervision.

I will consider each point in succession, and show how they have been provided for.

The first requirement is that we shall have a means of communication between two stations—not necessarily a speaking telegraph—which shall give notice of the approach and departure of a train, its nature,—that is, whether it is passenger, or goods, express or special—and to which company it belongs, when two or more companies have running powers over the same line. Now the custom universally adopted by railway companies to distinguish trains, in addition to the particular discs and lights carried upon the buffer plank of the engine, is to blow the whistle a certain number of times when approaching a junction or station. The same system is adopted with electric signals, only in place of blowing the whistle we sound a bell. The construction of the bell used is wonderfully simple. It is shown in Fig. 1.

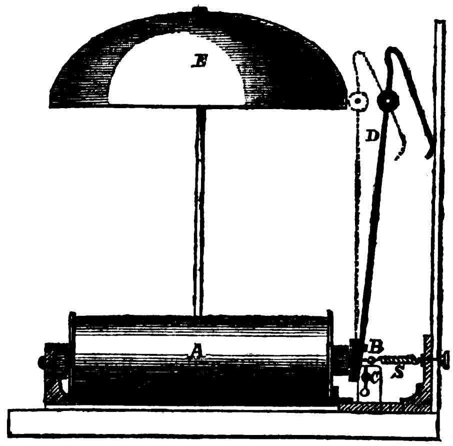

Fig. 1.

A is an ordinary electro-magnet, consisting simply of a bar of iron surrounded by a quantity of fine silk-covered copper wire, and B is a flat piece of soft iron, called an "armature," working upon the centre C, to which is attached a small rod and hammer, D. Now, whenever a current of electricity is passed through the electro-magnet, the iron bar becomes a magnet, the soft iron armature B is attracted towards it with a sharp movement, which causes the hammer D, by the elasticity of the rod, to strike the bell E, and emit the required sound.* S is an adjusting spring to return the hammer to its normal position when the current ceases to flow.

Every current of electricity transmitted through the wire produces one blow upon the bell, and by varying the number of currents sent we can form a complete code of signals. For instance :—

1 blow	Acknowledgment.†
2 blows	Passenger train.
3 "	Goods "
4 "	Special, Engine, &c.
5 "	Obstruction signal.
&c.	&c.

This code can of course be varied at pleasure to suit the different requirements of the line upon which it is fixed. Thus at Kensington station to which place four different companies send their traffic—

2 beats would represent	North Western Trains.
3 " "	Great Western.
4 " "	Brighton.
6 " "	South Western.

If it be necessary to distinguish the difference between the passenger and goods trains of those different companies it is only necessary to give the signal *once* for passenger and *twice* for goods trains. It is possible to give fifteen distinct and unmistakeable signals upon a bell by varying the number of beats and repetitions, but six or seven are ample for all the requirements of railway signalling.

These bells are made of numerous sizes and forms to suit the various localities in which they are placed. The dome G can be made to sound any note from a shrill treble to a deep bass, so that when two or more bells are fixed in the same hut they can be easily distinguished. By increasing the size and length of the wire around the electro-magnet the loudness of the sound of the blow can be similarly increased so as easily to reach a

* This is the simple principle upon which every electro-magnetic apparatus is based. A current of electricity, when passing around it, has the power of converting an iron bar temporarily into a magnet, and thereby causing it to attract or repel iron or steel.

† Given in reply to every signal sent, as an acknowledgment of its receipt.

man when he is outside his box attending to points or altering signals, even amidst the roar of passing trains or the noise of engines blowing off steam. It is customary to distinguish up trains upon a bell, as depicted in the above figure, and down bells upon a gong made of a piece of thick steel wire spirally set. The difference in the two sounds is very striking, but there are some objections to the use of gongs, which render them unpopular. They are very easily displaced out of regulation when cleaning the instrument. The sound has very little penetration—it is scarcely audible at a distance from the hut. They quickly rust from steam and damp. The men do not like them, and as a rule the opinion of the men themselves upon questions of detail of this nature is generally right and always valuable. I have had to replace many gongs with bells, and have determined to abandon their use, and substitute bells of different notes to distinguish the up and down trains, in every case where a man is not confined to his box.

The instrument employed to sound the bell, which is technically called a "key," is shown in the annexed sketch. Every depression of the button A transmits a current of electricity to the other station, and there sounds the bell or gong.

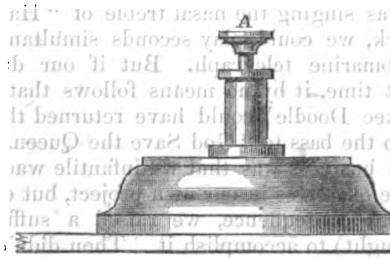

FIG. 2.

Its internal construction is shown in Fig. 3.

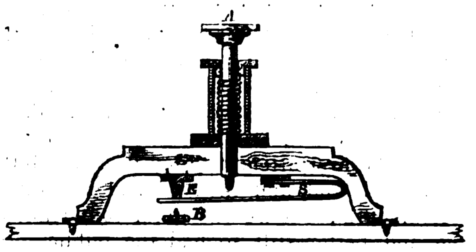

FIG. 3.

S is a spring which normally rests against the stud F, but which by the depression of the piston-rod A is brought into contact with B. The spring S is in connection with the bell-wire, and B with the battery, so that whenever S touches B a current of electricity passes which sounds the bell at the other station.

There are numerous forms of keys used upon different lines, but I prefer the one described for its strength and simplicity. Signalmen are usually very rough in handling electric apparati. A man has probably been engaged in exerting all his strength in pulling off some very distant semaphore, and enters his box hastily to give the required signal. He forgets the difference of force required to work the two instruments. He depresses the key with the same energy that he would work his out-door signals; and, unless it is made very strong, he is sure to commit damage. Any herculean signalman can exert his whole muscular energy upon these "piston-keys" or "plungers," as they are variously termed, without effecting the least injury. They are also very clean, and no dust can well enter the case, and dirty the contact points—a source of great evil in all electrical apparatus. Cleanliness and freedom from dust are essential to maintain uninterrupted working in signalling instruments, and the more this can be maintained without appealing to the care of the men by protecting the moveable parts in tight cases, the more certainty will there be in the action of the instrument. The manner in which the bell-wire works, and the bells and keys are fixed, will be fully illustrated by diagram in a subsequent number.

It will, however, be seen that in these bells we possess a perfect means of communication between two stations, by which the entry and exit of trains are clearly obtained. Bells of the above description are applicable in innumerable positions upon railways. Indeed, it may be said that wherever notice is required of the approach of a train, such as level crossings, station platforms, pointsmen's boxes, &c., they can be fixed. At every level crossing, without exception, on the South Eastern line, bells are placed in the gate-houses, which indicate to the gateman the approach of up and down trains.

There is a mechanical bell which is extensively employed upon railways, generally known as the "Bell-and-Arm," and sometimes as the "Lever-bell," which is sounded by pulling over a lever drawing a wire, like an ordinary signal, and thereby releasing a stout spring which drives the hammer against the dome with great force. They are very troublesome through the expansion and contraction of the wire from the effects of temperature. They have in several instances on the South Western line been replaced by electric bells with marked success. The men infinitely prefer them. Electric bells are not affected by temperature. They can be made loud enough for any practical purpose. They can only get out of order through carelessness, if properly constructed. Their action depends upon the battery, and if this is always kept in good order by those who have charge of its maintenance, electric bells should never fail nor ever give trouble. Bells of poor construction will of course break down, and the only remedy for this is of course to eschew such inferior articles.

As this paper is intended to be chiefly a description of the signalling apparatus as employed by me on the London and South Western Railway, I cannot enter into any description of the appliances adopted upon other lines, and in any other countries, to effect the same object. They are as numerous as they are ingenious, and would form an admirable subject for a series of papers in this Journal.

(*To be continued.*)

ELECTRO-MOTIVE FORCE IN ONE OF THE SIDES OF WHEATSTONE'S DIFFERENTIAL RESISTANCE MEASURER.

By R. S.

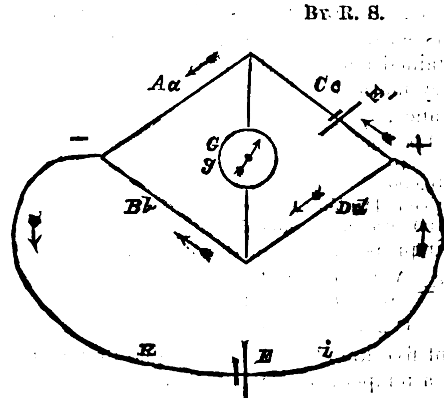

FIG. 1 represents the general plan of a Wheatstone's bridge, with an additional electro-motive force in the side, C.

Let the resistances, A, B, D, of the bridge be given, also the electro-motive forces, E and E′, and the resistance, R, of the battery circuit (—E+). It is required to find the value of the resistance, C, when the intensity, g, in the bridge, through the galvanometer $= 0$.

a, b, c, d, i, and g are the intensities.

By Kirchhoff's laws,

1) $a - c = 0$

2) $b - d = 0$

3) $iR + Dd + Bb = E$

4) $i - c - d = 0$

5) $Cc - Dd = \pm E'$

6) $Aa - Bb - Dd + Cc = \pm E'$

From 2) and 3)

$$iR + b(D + B) = E$$

and from 1) and 6)

$$c(A + C) - b(B + D) = \pm E'$$

Eliminating i and c from these equations by means of 2), 4), and 5), we have

$$R\left(\frac{\pm E' + Db}{C}\right) + b(R + D + B) = E$$

and

$$\left(\frac{\pm E' + Db}{C}\right)(A + C) - b(B + D) = \pm E'$$

The former gives the value of b,

$$b = \frac{CE \mp RE'}{R(D + C) + C(D + B)}$$

and the latter,

$$b = \pm \frac{AE'}{BC - AD}$$

Which equated against each other, and C obtained

$$C = \frac{AD}{B} \pm \frac{E'}{E} \cdot \frac{A(D + R) + B(A + R)}{B}$$

If $E' = 0$, or no electro-motive force is inserted in the side, C, of the bridge, then

$$C = \frac{AD}{B}$$

the common relation of the system of Wheatstone.

If $R = 0$ or the resistance of the battery, E, and of its connections to + and −, is inappreciable in comparison with the remaining resistances, then

$$C = \frac{AD}{B} \pm \frac{E'}{E} \cdot \frac{A(B + D)}{B}$$

and if, in addition to this, $A = B = D = n$, and $E = E'$,

$$C = n \pm 2n$$
$$= 3n, \text{ or } -n$$

Now, a resistance cannot be negative, therefore the condition of $g = 0$ can never be fulfilled when $E = E'$ at the same time that the resistances in the three sides of the bridge are equal to each other, and the currents of the batteries opposed. When, however, the currents of the batteries circulate in the same direction in the side, C, and $E = E'$, and $A = B = D = n$, as before, we must make C three times as great as either of the other sides, or, in other words, equal to their sum, to get the condition $g = 0$.

If the battery, E′, were well insulated the method might be found useful for testing the resistances of cables, while the bridge would retain its sensibility by the greater equality which might be thus maintained between the intensities, a, b, c, and d, than by the ordinary method.

Supposing, for instance,

A = 1,000 units
B = 10 „
D = 10,000 „
E = 1 cell (Daniell's)
E′ = 100 ditto in the same direction,

These inserted in their proper places in the formula

$$C = \frac{AD}{B} + \frac{E'}{E} \cdot \frac{A(B + D)}{B}$$

give

$$C = 101 \cdot 1 \text{ millims.}$$

about the resistance of five knots of Atlantic cable under atmospheric pressure, and a temperature of 75° Fah.

A thermo-electric current which was found to exist in using a bridge consisting of a long fine wire for the sides, A and B, a standard resistance at 32° Fah. in the side D, and a body of melted metal contained in a glass tube in the side C, suggested this little exercise.

THE ATLANTIC TELEGRAPH ENTERPRIZE.

By Amicus.

Newfoundland to Ireland, or from Ireland to Newfoundland, which you please; the question is whether, by virtue of the Yankees' being the "tallest nation," by a "tarnation slice," it is not entitled to precedence. True, Newfoundland is no part of the glorious model Republic—"the home of the brave," "the land of the free," &c.; but what then? it is on the same continent, is it not? and that is sufficient; and by-and-bye it will be absorbed, sucked in, or some such process, when that little bit of a job is finished down South, and Albion and Gaul have been "licked."

Eight years ago we telegraphists were just beginning to toddle, and like young venturesome, *ætat* eleven months and ten days, who thought he could strut across the room because he had succeeded in putting his right foot three inches in advance of his left for the first time, after repeated failures to maintain his centre of gravity, we likewise imagined, because we had connected Dover with Calais, and two or three other similar feats, we could also connect the two hemispheres, and while Jonathan was singing the nasal treble of "Hail Columbia" at New York, we could play seconds simultaneously by means of our submarine telegraph. But if our dream had come true at that time, it by no means follows that the performers of "Yankee Doodle" could have returned the compliment by taking up the bass to "God Save the Queen."

The best of the business was that we infantile waddlers had not only confidence ourselves in our own project, but everybody else had; and as a consequence, we raised a sufficiency of capital (as we thought) to accomplish it. Then didn't we strut and swell, and threaten "to put a girdle round the earth," and all sorts of fine things, with not so much as a thought upon the upsetting of our equilibrium. And we did it, too. It was a grand experiment, entitled to sympathy and support, and the public gave us largesse without stint, hoping, of course, to derive some benefit from the concern, and that they did not who deplores more than we? Never mind: seven years have passed since then, and although we have toppled over sundry times in the interval, we have determined, like Barnarby's parrot, never to say "die." Yes, some seven years ago our cable broke, in the first attempt to lay it, about 400 miles or so from the Green Island, and then we had to shut up for near upon a twelvemonth; but we had great confidence in ourselves all the time, and, better still, so had the public. So in '58 we solved the great problem scientifically and mechanically, and afforded Paddy an opportunity, if he had chosen to embrace it, of making over "Ould Oireland" *en masse* to the allegiance of Uncle Sam. Perish the quibbler who says he does not believe a message was sent through. Were you a shareholder, my man? If not, why then shut up; perhaps that is not polite, so good friend, oblige us with the proofs that we did not speak through the cable. Bah, one has no patience with a parcel of croakers. Why, man, there were three hundred messages sent through the short-lived cable, and that, every one will allow, was a good stroke of business for so short a time.

And we have gone on learning to walk all this time, and although we have ever and anon been feeble at the knees—nay, indeed, have had several falls and been severely bruised—we, nevertheless, managed to get on our pins again, and now do certainly feel stronger and better than we did. We certainly have not that overweening confidence in ourselves that we had before we made the essay at all, and it is but just to observe that the public have betrayed a still greater want of confidence in our abilities. This is not to be wondered at; over-confidence always suffers from a rebound, just as everything else does that is stretched beyond all reasonable limits.

Close upon the heels of our Atlantian prostration followed the collapse of the Red Sea cable, and two or three other

miserable matters, of which our poor person still retains the scars; but these are pretty well healed over now, and, indeed, we feel like a giant refreshed. (No, no; we are deaf at that ear. Somebody is whispering about the luckless shareholders of the old Atlantic telegraph having ugly wounds that still look red and inflamed; and about the national taxpayer—otherwise Mr. J. Bull—who is dreadfully sore about that Red Sea job, and considers his wounds bleed preciously, periodically. Clearly, however, we are not the right people for this worthy to come grunting to; we refer him to Downing-street. To the former we say, "Cheer up, you will be all right by-and-bye. Two hundred messages per day at 70s. each! look at that, and keep your own counsel.")

Let the Fates be praised, is not the considerable success of the Malta and Alexandria cable a proof that we have really begun to go; and reverting to the tardiness of public support now-a-days, we may be allowed to say that this line presents to them an instalment of the right sort of thing—an earnest of what we will do if they will only tip up. It is hard work certainly to struggle against wind and tide, but we mean to span the Atlantic in spite of everything comprised in cold shoulders, shrugged or otherwise. Yes, if we had waited for our old friend the public (many thanks for past favours), we should not have done this bit of business, which we hope will be quite completed by the eventful year 1866 (*vide* the modern prophets), until, perhaps—why no one knows when. But again let the Fates be praised; joint-stock undertakings are the levers wherewith we will revolutionize the world, and we mean to lace its old sides with telegraphic wicker-work, and to begin with, we shall demonstrate practically that telegraphic communication can be permanently and profitably laid and worked across the Atlantic. How many times we shall span it with separate cables is as yet undecided; but once having submerged one all right, we shall most assuredly go ahead, and attempt to realise that little bit of poetry respecting China, Australia, and various antipodean regions, which are to be electrically tacked to our tight little island in three years from date hereof. And as to intended operations in the Pacific, Arctic, Antarctic, and other oceans and seas, during the ensuing decennial period, why it would take one's breath away to make the catalogue; so forbear, little sprite, for the present, and let us confine ourselves to the matter in hand.

Yes, yes, joint-stock, that's the word now-a-days. Towards a renewed effort to attain this linking of the two hemispheres we have by this means, though not without tremendous private exertions, secured a goodly share of the required capital; and when we have got our cable laid, and in nice working order, with more work to do than we can get through, and all so profitable and pleasant, won't some sundry old stingers cry "peccavi;" but it will be of no use then, and they shall not revenge themselves on us by landing an opposition cable on our chartered territory. The amalgamation of two first-class firms into the Telegraph Construction and Maintenance Company have just afforded us the very means of doing the very thing we wanted to do.

This company consists of generous fellows, and they have stretched out the hand of fellowship to the directors of the Atlantic Telegraph Company in noble style. Here is the contract for making and laying, and all the rest, arranged as nicely as possible; and doubtless the work will be done to the mutual satisfaction of all parties, and to their profit also. And then all the world will profit by it as well, only think of that! There is a disinterestedness, too, about the terms of the contract and arrangements beyond all praise. Profit is contingent upon complete success. Who else would have manifested such magnanimity as herein immortalizes the T. C. and M. C.? And who else, pray, but the body whose initials are the foregoing would have taken up so goodly a portion of the unissued shares of the Atlantic Telegraph Company?

And now, be it known, we shall commence operations in 1865—that is, to lay the cable; it is in process of manufacture, as you very well know; the "core" is lengthening out, and the entire covering is also being applied; in all these matters, however, everybody is, or should be, well posted up. It will not be the editor's fault if you are not; and so we will pass on, please.

The old cable differed in many important respects from the one now in hand; this you also know, and these, therefore, are so many words thrown away; but they (not the verbiage) may be said to denote no inconsiderable advance in electrical science and telegraph cable manufacture.

There are plenty of people, no doubt, who will be very fast at criticising, ridiculing, and otherwise trying to bring both the cable and its promoters into contempt; but then, if this were not so, we know very well that it would afford a satisfactory proof that we were not living in the world—on this side of the millenium at least. We may surely say this much without having it attributed to us, that we affirm this cable to be beyond criticism, as the best that could possibly be devised. In fact, we are rather chary in our praises of it, not because it is not deserving of praise, but rather that we are exceedingly bashful, and would rather some one else did this part of the business; and we decidedly object to "damn it with faint praise," and so will merely say it is the result of careful inquiry, dearly bought experience, scientific deductions, and sundry other excellent motives which are always supposed to produce a good thing if properly worked together with a good leaven. At the risk of being thought egotistical, we will just remark that it is probably the best form of submarine telegraph at present available for submersion in very deep water, and for so long a stretch. It is a stupendous work, my masters, considering we telegraphists are yet in our non-age; but dear, dear, we shall arrive at puberty directly, and then manhood is close upon us.

To write on telegraphic matters is to repeat oneself *ad infinitum*, and sometimes *ad libitum*; this we particularly wish to avoid, and yet keep falling into it every dozen lines or so. Wonder if it will be considered repetition if we give the names of the scientific consulting committee? No, we will not; those who do not know ought to, and those who do do not want to be told. No doubt we shall be told as it is, that this body puts us in mind of an allopath, a homœopath, a herbalist, the founder of the College of Health, the village apothecary, and the doctoress who lives in the mud cottage down the lane that leads nowhere, all met together to decide as to the best way of treating young Harry Jones, who is down with the croup. A pretty way, indeed, to speak of eminent men, doctors and professors. What has become of the respect due to eminence and worth? For shame, ye carping critics! Would you have these worthy gentlemen leave the domain of tried experience to launch forth in a limitless, fathomless, untried ocean of theories, and that in so important a matter as an Atlantic telegraph? Now you just let these theories rest until we have time to attend to them.

These gentlemen agreed to differ, and that ought to satisfy everybody. What does it matter if any one of them, in a moment of excessive and indefensible candour, should impugn all personal responsibility as to having advised this or that? The constituents of this cable are precisely like all preceding ones—*i.e.*, copper (pray, what other conductor would you have?), gutta-percha, "ha! hum!" (pooh, what would you have, man?), hemp (an excellent material), and iron. A truce to your objections. The question is, whether the manufacture of a cable has not as much or more to do with its permanence and efficiency than the materials of which it is composed? being yet in our adolescence, however, we refrain from speaking too positively on this point, as also some others; we will treat you to a dogmatic discourse before long. We may just observe, however, that there are manifest improvements observed in the

manufacture, as it proceeds, that were never observed in any other cable.

The directors of the Atlantic Telegraph Company adopted this style of cable upon the recommendation of the report of the scientific consulting committee, who had a great many different forms to choose from, all of which were more or less subject to experiments in order to test their eligibility. So no more mouthing, please; this fact speaks for itself; and their being an heterogeneous conglomerate of discordant elements is all moonshine, besides being a slur upon the eminent conclave.

And then the contractors, to whom we have already referred, are well up in their business, have had a vast deal of experience, and, as we have seen, are by no means indisposed to share the risk; just the individuals are they to help us at this critical stage. Hurrah! then, and a fig for your prophecies. We will have something else to say next week, perhaps, on the detail of its component parts.

REPORT ON STANDARDS OF ELECTRICAL RESISTANCE.*

The Committee an Electrical Measurements, appointed in 1862, have not confined their attention to determining the best unit of electrical resistance, the point to which the duties of the committee of 1861 were nominally restricted, but have viewed this comparatively limited question as one part only of the much larger subject of general electrical measurement. The committee, after mature consideration, are of opinion that the system of so-called absolute electrical units, based on purely mechanical measurements, is not only the best system yet proposed, but is the only one consistent with our present knowledge both of the relations existing between the various electrical phenomena and of the connection between these and the fundamental measurements of time, space, and mass. The only hesitation felt by the committee was caused by doubts as to the degree of accuracy with which this admirable system could be or had been reduced to practice.

The measurement of voltaic currents, electromotive force, and quantity would offer little difficulty, provided only electrical resistance could be measured in absolute units; and for this purpose it would be sufficient that the resistance of a single standard conductor should be so determined, since copies of this standard could be multiplied at will with any desired precision; and from comparison with these copies, the absolute resistance of any circuit whatever could be obtained by methods requiring comparatively little skill and well known to all electricians. The practical adoption of the absolute system was felt, therefore, to depend on the accuracy with which the absolute resistance of some one standard conductor could be measured; and while doubts existed on this point, it was thought premature to make any extended experiments on the application of the absolute system to voltaic currents, electromotive force, or quantity. The committee are happy to report that these doubts have been dispelled by the success of the experiments made for the committee by Professor J. Clerk Maxwell, Mr. Balfour Stewart, and Mr. Fleeming Jenkin, according to the method devised by Professor W. Thomson. These experiments have been actively prosecuted at King's College for the last five months with continually increasing success, as, one by one, successive mechanical and electrical improvements have been introduced, and the various sources of error discovered and eliminated.

The sub-committee are confident that considerably greater accuracy can yet be obtained by the further removal of slight defects, the importance of which only became apparent when the main difficulties had been overcome. In order, therefore, to secure the best attainable result, and still further to test the accuracy and concordance of the experiments before taking any irrevocable step, the committee have decided not to issue standard coils at the present meeting; but the results already obtained leave no room for doubt that the absolute system may be adopted, and that the final standard of resistance may be constructed without any serious delay. Over-haste might eventually entail corrections as inconvenient as those which follow an arbitrary and unscientific choice of units; and the very experiments made by the sub-committee prove that the hesitation of many to adopt the absolute units as hitherto determined was well founded. It is certain that resistance-coils purporting to have been constructed from previous absolute determinations do not agree one with another within 7, 8, or even 12 per cent.

Before further alluding to the results obtained by the sub-committee, it is desirable that the experiments themselves should be understood; and to this end the committee have thought fit that a full explanation of the meaning of absolute measurement, and of the principles by which absolute electrical units are determined, should form part of the present report, especially as the only information on the subject now extant is scattered in detached papers by Weber, Thomson, Helmholtz, and others, requiring considerable labour to collect and understand. In order to make this account as clear as possible, it has been thought best to disregard entirely the chronological order of the discoveries and writings on which the absolute system is founded, and this has rendered it very difficult to refer to the original source of each statement or conclusion.

The word "absolute" in the present sense is used as opposed to the word "relative," and by no means implies that the measurement is accurately made, or that the unit employed is of perfect construction; in other words, it does not mean that the measurements or units are absolutely correct, but only that the measurement, instead of being a simple comparison with an arbitrary quantity of the same kind as that measured, is made by reference to certain fundamental units of another kind treated as postulates. An example will make this clearer. When the power exerted by an engine is expressed as equal to the power of so many horses, the measurement is not what is called absolute; it is simply the comparison of one power with another arbitrarily selected, without reference to units of space, mass, or time, although these ideas are necessarily involved in any idea of work. Nor would this measurement be at all more absolute if some particular horse could be found who was always in exactly the same condition and could do exactly the same quantity of work in an hour at all times. The foot-pound, on the other hand, is one derived unit of work, and the power of an engine when expressed in foot-pounds is measured in a kind of absolute measurement, *i.e.*, not by reference to another source of power, such as a horse or a man, but by reference to the units of weight and length simply—units which have been long in general use, and may be treated as fundamental. In this illustration, chosen for its simplicity, the unit of force is assumed as fundamental, and as equal to that exerted by gravitation on the unit mass; but this force is itself arbitrarily chosen, and is inconstant, depending on the latitude of the place of the experiment.

In true absolute measurement the unit of force is defined as the force capable of producing the unit velocity in the unit of mass when it has acted on it for the unit of time. Hence this force acting through the unit of space performs the absolute unit of work. In these two definitions, time, mass, and space are alone involved, and the units in which these are measured, *i.e.*, the second, gramme, and metre, will alone, in what follows, be considered as fundamental units. Still simpler examples of absolute and non-absolute measurements may be taken from the standards of capacity. The gallon is an arbitrary or non-absolute unit. The cubic foot and the litre or cubic decimetre are absolute units. In fine, the word absolute is intended to convey the idea that the natural connexion between one kind of magnitude and another has been attended to, and that all the units form part of a coherent system. It appears probable that the name of "derived units" would more readily convey the required idea than the word "absolute," or the name of mechanical units might have been adopted; but when a word has once been generally accepted, it is undesirable to introduce a new word to express the same idea. The object or use of the absolute system of units may be expressed by saying that it avoids useless coefficients in passing from one kind of measurement to another. Thus, in calculating the contents of a tank, if the dimensions are in feet, the cubic contents are given in cubic feet, without the introduction of any coefficient or divisor; but to obtain the contents in gallons, the divisor 6·25 is required. If the power of an engine is to be deduced from the pressure on the piston and its speed, it is given in foot-pounds or metre-kilogrammes per second by a simple multiplication; to obtain it in horse-power the coefficients 33,000 or 550 must be used. No doubt all the natural relations between the various magnitudes to be measured may be expressed and made use of, however arbitrary and incoherent the units may be. Nevertheless the introduction of the numerous factors then required in every calculation is a very serious annoyance, and moreover, where the

* This Report was prepared by a Committee appointed by the British Association, consisting of Professor Wheatstone, Professor Williamson, Mr. C. F. Varley, Professor Thomson, Mr. Balfour Stewart, Mr. C. W. Siemens, Dr. A. Matthiessen, Professor Maxwell, Professor Miller, Dr. Joule, Mr. Fleeming Jenkin, Dr. Esselbach, and Sir C. Bright.

relations between various kinds of measurement are not immediately apparent, the use of the coherent or absolute system will lead much more rapidly to a general knowledge of these relations than the mere publication of formulæ.

The absolute system is, however, not only the best practical system, but it is the only rational system. Every one will readily perceive the absurdity of attempting to teach geometry with a unit of capacity so defined that the contents of a cube should be 6¼ times the arithmetical cube of one side, or with a unit of surface of such dimensions that the surface of a rectangle would be equal to 0·000023 times the product of its sides; but geometry so taught would not be one whit more absurd than the science of electricity would become unless the absolute system of units were adopted.

In determining the unit of electrical resistance and the other electrical units, we must simply follow the natural relation existing between the various electrical quantities, and between these and the fundamental units of time, mass, and space. The electrical phenomena susceptible of measurement are four in number—current, electromotive force, resistance, and quantity. The definitions of these need not now be given. Their relations one to another are extremely simple, and may be expressed by two equations.

First, by Ohm's law, experimentally determined, we have the equation

$$C = \frac{E}{R}, \qquad (1)$$

where C = current, E = electromotive force, and R = resistance. From this formula it follows that the unit electromotive force must produce the unit current in a circuit of unit resistance; for if units were chosen bearing any other relation to each other, C would be equal to $x\frac{E}{R}$, where x would be a useless and absurd factor, complicating all calculation, and confusing the very simple conception of the relation established by Ohm's law.

Secondly, it has been experimentally proved by Dr. Faraday that the statical quantity of electricity conveyed by any given current is simply proportional to the strength of the current, whether electromagnetically or electrochemically measured, and to the time during which it flows; hence, in mathematical language, we have the equation

$$Q = Ct, \qquad (2)$$

where t = time, and Q = quantity. From this equation it follows that the unit of quantity must be the quantity conveyed by the unit current in the unit of time; otherwise we should have $Q = yCt$, where y would be a second useless and absurd coefficient. From equations (1) and (2) it follows that only two of the electrical units could be arbitrarily chosen, even if the natural relation between electrical and mechanical measurements were disregarded. Thus if the electromotive force of a Daniell's cell were taken as the unit of electromotive force, and the resistance of a metre of mercury of one millimetre section at 0° were taken as the unit of resistance, it would follow from equations (1) and (2) that the unit of current must be that which would be produced by the Daniell's cell in a circuit of the above resistance, and the unit of quantity would be the quantity conveyed by that current in a second of time. Such a system would be coherent; and if all mechanical, chemical, and thermal effects produced by electricity could be neglected, such a system might perhaps be called absolute. But all our knowledge of electricity is derived from the mechanical, chemical, and thermal effects which it produces, and these effects cannot be ignored in a true absolute system. Chemical and thermal effects are, however, now all measured by reference to the mechanical unit of work; and therefore, in forming a coherent electrical system, the chemical and thermal effects may be neglected, and it is only necessary to attend to the connexion between electrical magnitudes and the mechanical units. What, then, are the mechanical effects observed in connexion with electricity? First, it has been proved that whenever a current flows through any circuit it performs work, or produces heat or chemical action equivalent to work. This work or its equivalent was experimentally proved by Dr. Joule to be directly proportional to the square of the current, to the time during which it acts, and to the resistance of the circuit; and it depends on these magnitudes only. In mathematical language this is expressed by the equation

$$W = C^2 Rt, \qquad (3),$$

where W = the work equivalent to all the effects produced in the circuit, and the other letters retain their previous signification. This is the third fundamental equation affecting the four electrical quantities, and represents the most important connexion between them and the mechanical units. From equation (3) it follows (unless another absurd coefficient be introduced) that the unit current flowing for a unit of time through a circuit of unit resistance will perform a unit of work or its equivalent. If every relation existing between electrical and mechanical measurements were expressed by the three fundamental equations now given, they would still leave the series of units undefined, and one unit might be arbitrarily chosen from which the three other units would be deduced by the three equations; but these three equations by no means exhaust the natural relations between mechanical and electrical measurements. For instance, it is observed that two equal and similar quantities of electricity collected in two points repel one another with a force (F) directly proportional to the quantity (Q), and inversely to the square of the distance (d) between the points. This gives the equation

$$F = \frac{Q}{d^2}; \qquad (4)$$

from which it would follow that the unit quantity should be that which at a unit distance repels a similar and equal quantity with unit force. The four equations now given are sufficient to measure all electrical phenomena by reference to time, mass, and space only, or, in other words, to determine the four electrical units by reference to mechanical units. Equation (4) at once determines the unit of quantity, which, by equation (2), determines the unit current; the unit of resistance is then determined by equation (3), and the unit electromotive force by equation (1). Here, then, is one absolute or coherent system, starting from an effect produced by electricity when at rest. The units based on these four equations are precisely those called by Weber electrostatical units, although it may be observed that he chose those units without reference to what is here called the third fundamental equation, or, in other words, without reference to the idea of work, introduced into the system by Thomson and Helmholtz.

The four equations are sufficient to determine the four units, and into this system no new relation can be introduced. The first three equations may, however, be retained, and a distinct absolute system established by substituting some other relation between electrical and mechanical magnitudes than is expressed in equation (4); and, indeed, the electrostatical system just defined is not that which will be found most generally useful. It is based on a statical phenomenon, whereas at present the chief applications of electricity are dynamic, depending on electricity in motion, or on voltaic currents with their accompanying electromagnetic effects. Now the force exerted on the pole of a magnet by a current in its neighbourhood is a purely mechanical phenomenon. This force (f) is proportional to the magnetic strength (m) of the pole of the magnet, and to the strength of the current (C); and if the conductor be at all points equidistant from the pole, or, in other words, be bent in a circle of the radius k round the pole, the force is proportional to the length of the conductor (L): it is also inversely proportional to the square of the distance (k) of the pole from the conductor, and is affected by no other circumstances than those named. Hence we have

$$f = \frac{CLm}{k^2}. \qquad (5)$$

From this equation it follows that the unit length of the unit current must produce the unit force on a pole at the unit distance. If the equations (1), (2), (3), and (5) are adopted as fundamental, they give a distinct absolute system of units, called by Weber the electromagnetic units. Equations (4) and (5) are incompatible one with another, if equation (2) be considered fundamental; but the electromagnetic units have a constant and natural relation to the electrostatic units. It will be seen that in the fundamental equation (5) of the electromagnetic system, besides the measurements of time, space, and mass, alone entering into the other equations, a fourth measurement (m) of a magnetic pole is required; but this measurement is in itself made in terms of the mechanical units, for the unit pole is simply that which repels another equal pole at unit distance with unit force. Thus in the electromagnetic, as in the electrostatic system, all measurements are ultimately referred to the fundamental units of time, space, and mass. The electromagnetic units are found much the more convenient when dealing, as we have now chiefly occasion to do, with electromagnetic phenomena.

The relations of the electromagnetic units one to another and to the mechanical units may be summed up as follows:—The unit current conveys a unit quantity of electricity through the circuit in a unit of time. The unit current in a conductor of unit resistance produces an effect equivalent to the unit of work in the unit of time. The unit current will be produced in a circuit of unit resistance by the unit electromotive force. The unit current flowing through a conductor of unit length will exert the unit force on a unit pole at a unit distance. (In the electrostatic system all the above propositions hold good except the last, for which the following must be substituted:—the unit quantity of electricity

will repel a similar quantity at the unit distance with a unit force.)

It remains to be explained how electrical measurements can be practically made in electromagnetic units. Of all the magnitudes, currents are the most easily measured, provided the horizontal force (H) of the earth's magnetism be known. Let a length (L) of wire be wound so as to form a circular coil of small section as compared with its radius (k).

Let a short magnet be hung in the centre of the coil placed in the magnetic meridian, as in the ordinary tangent galvanometer, and let the deflection produced by the current C be called d, then it is easily* proved from the fundamental equation (5) that

$$C = \frac{Hk^2}{L} \tan d. \qquad (6)$$

Thus, where the value of H is known, a tangent galvanometer only is required to determine the magnitude of a current in electromagnetic absolute measurement, although neither the resistance of the circuit nor the electromotive force producing the current may be known. The measurement of quantity can be obtained from that of a current by a make-and-break apparatus, or "Wippe," in a well-known manner, or by measuring the swing of a galvanometer needle when a single instantaneous discharge is allowed to pass through it. If, therefore, we could measure resistance in absolute measure, the whole system of practical absolute measurement would be complete, since, when the current and resistance are known, equation (1) (Ohm's law) directly gives the electromotive force producing the current. The object of the experiments of the sub-committee (made at King's College by the kind permission of the principal) was therefore to determine the resistance of a certain piece of wire in the absolute system, in order from this one careful determination to construct the material representative of the absolute unit with which all other resistances would be compared by well-known methods.

There are several means by which the absolute resistance of a wire can be measured. Starting from equation (3), Professor Thomson, in 1851, determined the absolute resistance of a wire by means of Dr. Joule's experimental measurement of the heat developed in the wire by a current;† and by this method he obtained a result which agrees within about 5 per cent. with our latest experiments. This method is the simplest of all, so far as the mental conception is concerned, and is probably susceptible of very considerable accuracy.

Indirect methods depending on the electromotive force induced in a wire moving across a magnetic field have, however, now been more accurately applied; but, before describing these methods, it will be necessary to point out the connexion between the electromotive force induced in the above manner and the fundamental equations adopted for the absolute system. The exact sense in which the terms are employed is defined in the accompanying footnote, along with simple corollaries from those definitions.‡

A current (C) in a straight conductor of length (L) crossing the lines of force of a magnetic field of the intensity (S) at right angles will experience the same force (f) as if all the points of the conductor were at the unit distance from a pole of the strength (S). The force in this case exerted on the magnet is, by equation (5), equal to SLC, and, conversely, an equal force is exerted by the magnet on the current. Hence we have equation (7), expressing the value of the force (f) exerted on a current crossing a magnetic field at right angles,

$$f = SLC \qquad (7)$$

Let us imagine this straight conductor to have its two ends resting on two conducting rails of large section in connexion with the earth, and let the whole sensible resistance (R) of the circuit thus formed be constant for all positions of the conductor. Let us further imagine the rails so placed that when the conductor slips along them it moves perpendicularly to the magnetic lines of force and to its own length. By experiment we know that when the conductor is moved along the rails cutting these lines of force, a current will be developed in the circuit, and that the action of the magnetic force on this current will cause a resistance (f) to the motion (due to electromagnetic causes only); and, by equation (7), we find that this resistance $f = SLC$.

Let the motion be uniform, and its velocity be called V; and let the work done in the unit of time in overcoming the resistance to motion due to electromagnetic causes be called W; then $W = VSLC$. But this force produces no other effect than the current, and the work done by the current must therefore be $= W$, or equivalent to that done in moving the conductor against the force f, but, by equation (3), $W = C^2R$, and hence

$$R = \frac{VSL}{C} \qquad (8)$$

(To be continued.)

* The resultant electromagnetic force (f) exerted at the centre of the coil by a current (C) will, by equation (5), be $f = \frac{CL}{k^2}$, and the short magnet hung in the centre will experience a couple acting in a direction perpendicular to the plane of the coil equal to $\frac{CLml}{k^2}$, where ml = the product of the strength of one of the poles into the length of the magnet, or, in other words, its magnetic moment. The strength of the couple acting perpendicularly to the axis of the magnet, when it has deflected to an angle d under the influence of the current, will be $\cos d \frac{CLml}{k^2}$, at the same time the equal and opposite couple exerted on the magnet by the earth's magnetism will be $\sin d\, Hml$, hence

$$C = \frac{Hk^2}{L} \times \frac{\sin d}{\cos d} = \frac{Hk^2}{L} \tan d.$$

† Phil. Mag. vol. ii. Ser. 4, 1851, p. 551.

‡ *Definition* 1.—A magnetic field is any space in the neighbourhood of a magnet.

Definition 2.—The unit magnetic pole is that which, at a unit distance from a similar pole, is repelled with unit force.

Definition 3.—The intensity of a magnetic field at any point is equal to the force which the unit pole would experience at that point.

Corollary 1.—A pole of given strength (S) will produce a magnetic field which (if uninfluenced by other magnetic forces) will at the unit distance from the pole be of the intensity S, *i.e.*, numerically equal to the strength of the pole; for, at that distance, the force exerted on a unit pole would, by def. 2, be equal to S, and hence, by def. 3, the intensity of the magnetic field at that point would be equal to S.

Definition 4.—The direction of the force in the field is the direction in which any pole is urged by the magnetism of the field; this is the direction which a short-balanced, freely suspended magnet would assume.

Remark.—The properties of a magnetic field, as shown by Dr. Faraday, may be conveniently and accurately conceived as represented by *lines of force* (each line representing a force of constant intensity). The direction of the lines will indicate the direction of the force at all points; and the number of lines which pass through the unit area of cross section will represent the magnetic intensity of the field resolved perpendicularly to that area.

Definition 5.—A uniform magnetic field is one in which the intensity is equal throughout, and hence, as demonstrated by Professor W. Thomson, the lines of force parallel.

Example.—The earth is a great magnet. The instrument-room, where experiments are tried, is a magnetic field. The dipping-needle is an instrument by which the direction of the lines of force is found. The intensity of the field is found by a method described in the "Admiralty Manual," 3rd edit., article "Terrestrial Magnetism." The number of lines of force passing through the unit of area perpendicularly to the dipping-needle in the room must be conceived as proportional to this intensity, and the direction to correspond with that of the dipping-needle. The magnitude and direction of the earth's force at a point are generally expressed by resolving it into two components, one horizontal and the other vertical. The mean horizontal component in England for 1862 was at Kew = 3·8154 British units, or 1·7592 metrical; *i.e.*, a unit pole weighing one gramme, and free to move in a horizontal plane, would, under the action of the earth's horizontal force, acquire, at the end of a second, a velocity equal to 1·7592 metres per second.

APPARATUS FOR MEASURING THE VELOCITY OF PROJECTILES.

The electro-ballistic apparatus, now in use at Woolwich and Shoeburyness, was invented by Major Navez, of the Belgian Artillery, for measuring a very small space of time—such, for instance, as a cannon-ball would take in passing over a few yards. Before we [*Illustrated London News*] proceed to explain this interesting machine, it will be necessary to remind our readers that an electric current has the property of magnetizing soft iron, and also to mention the peculiar principle of the pendulum. This is that the same pendulum will always, within certain limits, perform unequal vibrations in equal times—that is to say, that a "seconds" pendulum will always take "a second" to make one oscillation, whether it be raised from the perpendicular 20° or 5°. Consequently, supposing a seconds pendulum to be selected, we can take the arc it describes in one vibration, and, by dividing this arc into a scale of parts, we can arrest the pendulum as it falls; and the distance it has fallen, measured into the whole length of the arc, will give us the fraction of a second in which the fall took place. We see, then, with what extreme minuteness we can measure time by stopping the seconds pendulum before it has fallen the thousandth part of the arc in which

it would vibrate. The electro-ballistic apparatus is used for determining the velocity of a projectile, or the rate at which a shot proceeds after it leaves the muzzle of a gun. The instrument consists of three separate parts, one of which is a principal and the others accessories. The chief part consists of a graduated arc, on which a pendulum is so adjusted that it can be arrested at any period of its oscillation, and thus denote the time it has taken to fall. The pendulum, before an observation, is held suspended at the left extremity of the arc, by means of a piece of soft iron in the centre of the bob, which is magnetized by an electric current through an electro-magnet at the point of support. Connected with this magnet are two insulated wires, which pass away for two or three hundred yards, and terminate by the ends being wound across an upright screen, thirty yards in front of the gun, where the ends are joined, so that the electric circuit is complete. Another instrument is employed called the conjunctor, and performs the following office. At the top of it an electro-magnet, which is connected by wires with a second screen, 120 feet in front of the first—*i. e.*, 150 feet from the gun. These wires are insulated with gutta-percha, &c., so that they may be either buried in the ground or hung on posts. The electro-magnet in the conjunctor retains a small weight suspended over a cup of mercury. This has a steel blade above it, with a pin so arranged that if the weight falls it presses it into the mercury. The pendulum has an index or duplicate pendulum in rear, which is so attached to it by a light spring, that it will fall and oscillate with the pendulum proper. Behind the machine is a large electro-magnet, which has power to attract this index when magnetized.

Upon the gun being fired, the projectile cuts the wires of the first screen, and thus demagnetizes the electro-magnet which holds up the pendulum. This latter commences to fall, and the index-needle with it, along the graduated arc. When the second screen is cut through by the shot, the electro-magnet at the top of the conjunctor is demagnetized, and the weight falls into the mercury, pressing down the steel blade, and completes another electric circuit, which magnetizes the large magnet in rear of the pendulum, and clamps the index-needle against the scale on the arc. The operator then reads off the scale the distance which is marked by the index, and the time thus measured is that which the shot took to pass through the screens, minus the time necessary for the weight to fall in the conjunctor, and which the operator, before commencing, finds by means of the disjunctor. A table has been prepared which shows the time for the pendulum to fall down any arc from 0° to 150°, and only needs to be referred to for any arc through which it falls when used as above. The time thus given has only to be divided into the distance between the screens, and the result will be the velocity of the projectile. By this contrivance a skilful operator is able to measure pretty accurately to the three-thousandth part of a second. Such wonderful precision renders this instrument most valuable for artillery scientific purposes, and many most important problems have been solved by its use.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XVI.

A.D. 1841, January 11.—No. 8783.—Barwise, John, and Bain, Alexander.—"Improvements in the application of moving power to clocks and timepieces," consisting of:—

"A method of applying the pendulum of a regulating clock or timekeeper for making or breaking alternately the electric connection between the source of electricity and the electro-magnetic clocks and timepieces." A "regulating clock" conveys an electric current, and cuts it off periodically, by means of equidistant metal studs let into an ivory ring, over which a metal spring on the escape-wheel axis moves; the spring is connected with one battery pole, and completes communication with various wires leading to electro-magnetic clocks, each stud having a wire. Sixty studs giving motion to sixty clocks, are shown, so that each clock is moved once every minute if the pendulum beats seconds. A wire leads from each stud to one end of the coil of an electro-magnet in a clock or set of clocks, consequently every beat of the pendulum of the regulating clock will put in motion an electro-magnetic clock; the return wire to the battery is continuous, and is connected with the remaining terminal of the coil of the electro-magnet in each clock. The electro-magnetic clock consists of a train of wheels, the escape-wheel of which is moved one tooth by means of a spring and "catch-spring," fastened at its bottom angle, connected with a soft iron armature, every time an electro-magnet is discharged.

A "method of working simultaneously a number of clocks." The pendulum of the regulating clock completes the circuit every time a spring which it carries, connected with one battery pole, passes over a "metal conductor" connected with the other battery pole. This plan requires more battery power than the former.

A means of winding up the going and striking train and setting the hands of a clock once every hour. Sixty electro-magnetic clocks are connected with the positive and negative wire from the battery and regulating clock, but each clock only forms a closed circuit once every hour, when a metal stud inlaid in a disc comes into contact with a spring. An electric current is made to traverse once every minute by the regulating clock, which acts on that particular electro-magnetic clock in which the circuit is unbroken. In the electro-magnetic clock, a horizontal sliding bar is free to move backwards and forwards, by the attraction to the electro-magnet of a keeper fixed to the bar, and the reactive pressure of "a gun-lock spring;" this bar carries spring catches, working into the teeth of ratchet wheels on the main-spring axis of the going and striking trains; thus partly winding up the main-springs. Attached to the sliding-bar is an arm with prongs, which take hold of a projecting pin on the disc fixed to the minute-hand spindle, and, by the sliding motion, set it to its proper time; when the electro-magnet is discharged, the pin is out of the way of the prongs.

A method of bringing the minute hand of an ordinary clock "(provided it deviate not more than a minute from the time of the regulating clock) to exact time with the regulating clock," by actuating an electro-magnet whose keeper moves two clips working on pivots attached to the front plate of the clock; on the magnetism ceasing, the clips are separated by a spring forcing the keeper from the magnet. The circuit is completed at the proper time by a piece of metal inlaid in an ivory disc, over which a spring (in the circuit), fixed to the minute hand axis, traverses. By varying the position of the spring in each clock a number of clocks may be set in succession.

"A mode of supplying the voltaic battery with sulphate of copper or other suitable materials," by causing two rings, between which cups are free to turn, to revolve and bring levers on their axes into contact with a spring fixed on the battery cell, thus overturning the cups at certain times.

A number of wires for transmitting the above currents twisted together like a rope, "or the positive and negative wires are twisted with hemp or other fibrous rope."

A timepiece worked solely by electro-magnetism. The electro-magnet acts on a keeper fixed on to the pendulum, which has a "catch-spring" that works the "escapement wheel" connected with ordinary clockwork. A spring on a "sliding rod," worked by the pendulum by means of shoulders, comes periodically into contact with a "stud," and completes the circuit at suitable times.

Making a balance timekeeper transmit the electric current to other clocks, as in the first improvement, by a stud on the seconds wheel, which passes over an inlaid ivory ring.

"The application of an electric current to the striking of a clock." "The gathering palette wheel" "of the striking train, which makes one revolution for each blow of the hammer on the bell," has a projecting spring, which, striking against a stud, completes the electric circuit, and causes the hammer to strike the bell; for that purpose the hammer rod carries an armature which is attracted to the electro-magnet whenever the circuit is completed.

"A method of giving motion to a number of clocks." "By this method five" [three?] "long conducting wires are required." On a spindle of a pendulum or balance clock, a spring is fixed, connected with the positive battery wire, which moves uniformly over a fixed non-conducting disc, having two metallic half circles, with which two long conducting wires are respectively in contact; the current is thus transferred to the wires alternately. Another long conducting wire returns the electric current. Each electro-magnetic clock has two electro-magnets, each respectively connected with each positive wire; a soft iron frame is suspended between their poles, containing "catch springs" that work the clockwork. As soon as the frame of the first clock is attracted to its magnet it completes the circuit for the next clock, and so on; thus completing the circuit to as many clocks, in succession, as the time the regular spring is in contact with one half-circle will allow.

When the regulator spring moves over the other half circle it puts into action the second set of magnets.

A combination in which a regular clock, marking Greenwich time, enables uniform time to be shown throughout the country. A circuit to a distant station battery and regulator is actuated by the central regulator, that actuates a second, and so on. The clocks in the neighbourhood of each station may be worked as in the first improvement.

A.D. 1841, January 14.—No. 8793.—Jones, Alexander.—"Improvements in the manufacture of copper tubes and vessels." "Manufacturing tubes and vessels of copper deposited or thrown down in the form and of the substance of the tube or vessel required to be manufactured, by the action of voltaic electricity." "A solid or other mould, of the diameter and form of the required tube," is made of "wood, clay, earthenware, plaster of Paris, wax, or other non-conducting substance," "or the mould may be of lead or other metal fusible at a less degree of heat than the copper of which the tube is to be formed." A non-conducting mould is made conducting by the application of nitrate of silver solution, the metal being afterwards reduced by immersion in a solution of proto-sulphate of iron, or by phosphorus, either in solution or in vapour; or plumbago, metallic leaf or foil, or bronze powder, may be used. The mould is then placed in a vessel containing a solution of sulphate or nitrate of copper, connected to the "positive plate" of a suitable galvanic battery, and "surrounded by a cylinder of copper of a larger interior diameter than the required tube," which cylinder is connected with the "negative plate" of the battery; instead of a cylinder, clippings, turnings, or other refuse of copper," "placed in a frame of wicker work," may be connected to the "negative plate" of the battery. When the deposit of copper, thus caused, is of the required thickness, it may be removed from the mould either by mechanical force or by heat. It may be necessary to form vessels in separate portions, which may be done by galvanic electricity as follows:—Every part, except the edges to be joined and a small portion on each side, is coated with a "resinous varnish;" the parts are brought together as they are required to be fixed, the whole is immersed in the copper solution, and connected with the battery as aforesaid, with a copper plate in connection with the battery surrounding it. A single cell apparatus, with diaphragm and constant supply of sulphate of copper, may be used instead of a separate galvanic battery.

A.D. 1841, January 23.—No. 8809.—Baggs, Isham.—The title of this invention is, "Improvements in printing." The invention relates:—1st. To the application of "the chemical powers of electricity," "however obtained," "to the purpose of printing in one or more colours." When "quantity" electricity is used, a design is prepared for printing by forming the parts of various metals or metallic alloys, this design is placed upon paper "slightly moistened" with a suitable chemical solution, and the paper is placed upon "the negative pole of an active battery;" on the connection of the metallic design "with the positive wire," electro-chemical affinities operate, and a coloured impression of the design is produced. When "electricity of high tension and small quantity" is used, a design is "formed upon a glass plate by cementing upon its surface a number of small pieces of very fine platinum," or other metallic "wire, in consecutive order, so as to form a series; it is then to be laid upon a sheet of paper moistened with any appropriate solution," "and submitted to the action of a spark or current." 2nd. "To a mode of employing tests in printing," by using paper moistened with solutions of various re-agents, when more colours are required than one re-agent can produce.

A.D. 1841, March 8.—No. 8865.—Spencer, Thomas.—This invention is entitled, "An improvement or improvements in the manufacture of picture and other frames and cornices, applicable also to other useful and decorative purposes," and it relates to:—1st. The "application of voltaic electricity" to the above purposes, by taking a mould from a model of the required design, and a copper electrotype from that mould. The mould may be either cast in any suitable substance or electrotyped. If the mould is not metallic it must have its surface made conductable, preferably, by giving it a "coating of thin varnish;" when nearly dry, "bronze powder" is applied until the whole surface is "rendered metallic." The electric apparatus may be a single cell, but preference is given to the battery process. When the deposit is thick enough, the copper frame may be removed "by a slight application of heat." The back of the frame may be filled with solder, and a "rabbit" fastened entirely round it for the picture and glass to be fitted into. The frame is then ready to be gilt, silvered, or covered with platinum. 2nd. The "application of voltaic electricity to the manufacture of moulds" for casting "composition" and "papier mâché" ornaments, "also for casting glass, earthenware, and china." An exact model is fastened to a plate of polished metal or glass by varnish. The model and plate (if non-conductable) must then be "metalized" and electrotyped in copper, the electrotype may then be removed and tinned on the back, or it may be electrotinned before its removal from the model. Lead, or other suitable substance, is then poured on the back of the mould to make it "level." Moulds for casting in glass may be made by metallizing a cut and polished article of glass and depositing on it. 3rd. The "application of voltaic electricity for the purpose of making patterns or moulds for ironfounders in copper." For this purpose a cast is taken from an original pattern—if non-conductable, metallized—and electrotyped in copper. To obtain uniform thickness, the surface to be deposited on should be placed horizontal, opposite to the dissolving plate which lies at the bottom of the depositing vessel. 4th. The "use of bromine and iodine combined with gold, in conjunction with voltaic electricity, for the purposes above enumerated." Gold is dissolved in bromine, either by adding gold leaf, or by the help of alcohol, acetic acid, and sulphuric acid, in certain proportions; the gold plate being attached to the "platinum end of a galvanic battery." This solution is used slightly diluted. When a thick deposit of gold is required, "an ammoniacal salt" is added to the solution of gold; an alkaline carbonate is added, when the metal to be gilt reduces the gold by immersion. The solution of iodide of gold in "acetate or muriate of ammonia," or in "prussiate of potassa," may be used instead of the bromine solution. "A device or embossment" may be formed in gold by using "a reverse of the design" electrotyped by the above solution. 5th. "The use of bromine and iodine combined with silver, and in conjunction with voltaic electricity," for the purposes above enumerated. For an electro-depositing solution, silver dissolved in acetate of ammonia, proceeding as with gold, or in bromine and alcohol by electricity; the solution is suffered to rest "until a yellowish white precipitate takes place," which is dissolved in acetate of ammonia by boiling. Other ammoniacal salts or "prussiate of potassa" may be used; or a solution may be formed by dissolving an iodide of silver in "prussiate of potassa," or any of the ammoniacal salts. 6th. Methods of electro-coating metallic surfaces with platinum. To prepare the solution, the "platino-bichloride of ammonia" is added to weak hydrochloric acid, and boiled, or platinum is dissolved by electricity in "muriate of ammonia;" or when bromine is used, spongy platinum is dissolved in a mixture of alcohol and bromine, and dilute sulphuric acid added; or the "platino-bichloride of ammonia" may be combined with the alcoholic solution of bromine. Lead may be coated by either of these solutions, and used as the negative plate of a galvanic battery. 7th. "Covering metallic surfaces with tin." The solution used for electro-tinning is of "acetate of ammonia or muriate of that salt or suphat" [sulphate?] "of soda; this is used in the ordinary manner." 8th. Methods of cleaning the surfaces of iron that are to be coated with copper, and of electro-coating those surfaces. The iron is attached to the "platinum end of a voltaic battery," and immersed opposite to another iron surface, connected with the "zinc end," in a solution of sulphate of soda, or malleable iron may be cleaned by immersion in a solution of sulphate of zinc containing a very small quantity of any salt of copper. The iron is then to be electro-coated with copper by proper contact with a suitable galvanic battery, and immersion in a solution of "the acetate, sulphate, nitrate, or the ammonia acetate" [ammonia-acetate?] "of copper." 9th. A "method of producing embossed or enriched surfaces" on picture frames, &c., by the use of embossed calico, &c. 10th. The "application of caoutchouc" to improve "the texture of composition used to cast ornaments" for picture frames, &c.

A.D. 1841, March 29.—No. 8905.—Parkes, Alexander.—"Certain improvements in the production of works of art in metal by electric deposition." These relate "to the manufacture of works of art in silver and of gold, by causing these metals to be deposited by electric agency in or on suitable moulds or models," "in place of producing such articles by casting, or by pressure, or hammering, or stamping in dies or shapes." Under the heads of "internal" and "external" moulds, the specification and drawings describe various methods of making moulds from other moulds, models, or patterns, to electro-deposit gold or silver in or on, which moulds may be removed by heat or otherwise; a method of making the said moulds by electro-deposition; various means of making the moulds, such as employing wax, stearine, and fusible or other

metal, so that they may be removed from the deposit "by heat or solution;" making the moulds or models up of parts, so that they may serve for many copies of the deposited article, or to enable the moulds to be "highly finished," or "internal" moulds to be obtained in one piece from "external" patterns in parts; and a "mode of strengthening articles of gold and silver produced in or on moulds by electric depositions, by introducing a baser metal within them," either electro-deposited or by fusion. In an "internal" mould the face or pattern of the article is against the mould, and in an "external" mould the face is away from the mould, the mould merely imparting form by the equality of the thickness of the deposit. Details respecting solutions, fusible metal, coating and preparing non-metallic moulds, removal of moulds, battery, &c., are given.

A.D. 1841, April 27.—No. 8937.—Petrie, William.—"The application of the deflective action which exists between electric currents and magnets for "the purpose of obtaining a moving power." The specification and drawings describe and show an electro-motive engine in which "two rectangular helices" (one including the other) cross each other at right angles, and "are fixed in a suitable framework;" an axis, in proper bearings, passes freely through one side of the helices, and "on that part of the axis within the helices are placed magnets with similar poles adjacent;" these may either be electro-magnets or permanent magnets. A "current-changer" attached to the axis enables the electric current to traverse one helix, then the other, then again the first helix in the opposite direction, then the second helix in the opposite direction, and so on; thus producing a constant tendency of the magnets to deflect in the same direction, from each of the coils respectively, and giving, therefore, a rotary motion to the magnet's axis. A description of a "spark-preventer" is also given, in which a "bridge" on the "current-changer," "attached to a spring," is made to complete a "short circuit" between the poles of the battery during the changing of the current from one helix to the other, thus avoiding the disruptive discharge; two "bridges" are necessary, one for each helix. Another "spark-preventer" is also described, in which an additional "inlaid strip" on the current-changer," connected with one pole of the battery, is brought into connection with the other pole by one of the conductors proceeding to the helices, during the change of current. Remarks are made respecting the contruction and working of the engine, and the proportion of magnets and helices to battery power is minutely given.

A.D. 1841, May 14.—No. 8958.—Pinkus, Henry.—"An improved method or methods of applying electrical currents or electricity, either frictional, atmospheric, voltaic, or electro-magnetic." This invention relates to:—

The propulsion of "vessels at sea." Galvanic batteries are arranged on the external and internal sides of the ship, insulated from the vessel and from the sea by "a surface of pitched and resend felt," also "auxiliary" troughs are used. "The electro-magnetic engine of contact" (See No. 8644) by this means gives motion to the paddle wheels. To supply and circulate the sea water or other solution through the battery cells, and to assist in propelling the vessel, engines are erected in the ship, with "piston cylinders arranged with clack valves as blast cylinders for the compression or rarification of air, or arranged for forcing other fluids or water," worked by means of levers, connected to shafts proceeding through stuffing boxes to the outside of the vessel, the levers having floats, which move up and down according to the combined motions of the sea and the vessel. This "supply engine" compresses the air into reservoirs, and thus works an "auxiliary" engine connected to the paddle shaft; by means of pumps in connection with the tanks it also causes circulation through the battery cells. The "supply engine" may also have the bottoms of its cylinders open to the sea; its pistons will then be moved up and down at each motion of the vessel over the waves.

The application of the above electro-magnetic engine to canal propulsion. A "locomotive impelling engine" is mounted on a "suspension rail," and has toothed spur gearing working into a rack on the side of the rail, also horizontal guide wheels running on side rails; this engine is moved, either "by the electro-magnetic engine on the locomotive," or from the vessel by a cord passing round suitable pulleys; in the latter case, "a distending rod," capable of adjustment by nuts, and right and left handed screws, joins the centres of the pulleys; "the metallic circuits must be formed" as described in No. 8644.

Sealing and unsealing the "pneumatic valve," described in No. 8644. "Metallic circuits" are connected "with the valve mains, and so render" "soft iron bars," "magnets to hold down the flexible valve," by means of soft iron attached to its lips.

A.D. 1841, June 12.—No. 8987.—Palmer, Edward.—"Improvements in producing printing surfaces and printing china, pottery ware, music, maps, and portraits." These relate:—1st. To a mode of drawing and painting on a conducting surface, or on a surface afterwards made conducting, so that metallic plates, with sunken surfaces, can be obtained from them by the electrotype process, from which prints may be taken as from copper or steel plates. The drawing is made on a "whitened" plate with a dark composition (which is described, and the "handling" of it elucidated), the plate is then made conducting with plumbago (for instance), and electrotyped. 2nd. To a mode of drawing on the above-mentioned surfaces, so that metallic plates with raised surfaces, as in wood blocks, may be obtained for printing. The drawing is made on a "darkened" plate with a white composition (which is described, and the "handling" of it elucidated), the surface is then made conducting, and electrotyped. A method of "lowering the light parts" is given, which consists in pressing the original plate between millboard, thickened and cut out in appropriate places by a method described.

CHANGING IRON TO STEEL BY CARBONIC OXIDE.

M. Frederic Marguerite has recently presented a paper on this subject to the Academy of Sciences, Paris, from which *Le Genie Industriel* extracts the following:—

"The idea of carburation by a gas is due to Clonet, who thought that iron has such an affinity for carbon that at a very high temperature it would remove it even from oxygen. He relied for this opinion on the fact that having heated iron divided into small pieces with a mixture of carbonate of lime and clay, he obtained steel. He concluded that the carbonic acid of the carbonate of lime was decomposed, yielding its carbon to the iron.

"But Mushet, repeating the experiment of Clonet, operated with lime deprived of carbonic acid, or simply with sand, and obtained steel; thus demonstrating that the carbon was not furnished by the carbonic acid of the mixture, but by the gas from the furnace which penetrated through the walls of the crucible.

"Collet-Descotils and Marckensie proved that, in the same circumstances, the iron might be perfectly melted without its properties being sensibly altered.

"M. Boussingault, following rigorously the indications of Clonet, obtained a product which analysis demonstrated not to be steel, but the silicide of iron.

"Later, M. Leplay gave his ingenious theory of the treatment of minerals in high-furnaces, which he summed up thus:—

"Carbonic oxide reduces all the compounds, and carburets all the metals which can be reduced and carburetted by cementation.

"But in the researches followed in common by MM. Laurent and Leplay, the action of carbonic oxide was found absolutely null, and their experiments had for conclusion that carburetted hydrogen is the cause of the cementation and the carbonic oxide of the deoxidation.

"Thus it appears that this has not to the present time received solution. The aim of this note is to present the evidence of the direct carburetting action of carbonic oxide on iron.

"Here is the way the experiments were made:—

"Care was taken in the first place to protect the iron which was to be converted into steel from all extraneous action, by placing it in a porcelain tube varnished on the exterior and interior. These tubes are absolutely impenetrable to the gases of the furnace.

"The carbonic oxide employed was obtained by decomposing pure oxalic acid by means of sulphuric acid equally pure. This gas was separated from the carbonic acid which accompanied it by traversing several flagons filled with a solution of potassa, and was afterwards tested by passing it through a solution of baryta which did not become turpid.

"The carbonic oxide, retaining no further trace of carbonic acid, was passed through tubes containing potassa, and then through others containing pumice stone saturated with sulphuric acid, from which it came out absolutely pure and dry to enter the porcelain tube heated to a lively red. The iron submitted to the current of the gas was a fine wire which had been carefully brightened (*decape*). At the end of two hours of calcination, the cementation was complete, and during all the time of the experiment carbonic acid was disengaged; showing that the iron had decomposed the carbonic oxide. In acquiring all the properties of steel it had fixed carbon, augmenting its weight, and had eliminated oxygen which had produced the carbonic acid.

"Notwithstanding, M. Caron has made an observation very important on the decomposition of the carbonic oxide by the silicium contained in the iron. He demonstrated that silicide of iron, over which was passed a current of carbonic oxide at the temperature of fusion of cast-iron, decomposes that gas, producing silica, which floats on the surface, and carbon, which combines with the iron, so that the cementation would be proportioned to the silicium which the iron contained, and would be null if the iron were pure.

"I have made with care an analysis of the silicium contained in the iron on which I have operated. I obtained from 10·29 grammes of iron only 0g,009 of silica, of which the silicium, in decomposing the carbonic oxide, would have been able to deposit only 0g, 00356, and of carbon 0g, 00035, while the deposit of carbon amounts to 0g, 0048, considering only the augmentation of weight. This steel also has been analysed:—3·010 grammes were heated during four hours in a current of moist hydrogen. It lost 0g, 014, and after a new treatment of four and a half hours 0g, 0015, making for eight and a half hours a total loss of 0g, 016, which represents 0g, 0053 of carbon, in the place of 0g, 0048 indicated by the augmentation of the weight.

"It follows from these numbers that the influence of the silicium on the cementation by carbonic oxide, though very real, has performed in the specimen treated a part nearly insignificant.

"It is necessary then to admit a direct action between the carbonic oxide and the iron.

"Furthermore, to dissipate all doubts on this point, I have operated on some pure iron, prepared in accordance with the directions of M. Peligot, by heating oxalate of iron in a current of hydrogen. There was calcined for about three hours in presence of carbonic oxide 1·318 grammes of this iron, which increased in weight from 0g, 00265 grammes to 0g, 0035, and carbonic acid was constantly disengaged. Admitting—which was not the case—that this iron contained silicium or foreign metals, the two simultaneous facts of the carburation and the production of carbonic acid would be impossible, since these metals would fix oxygen in place of eliminating it, and it would be necessary to explain the considerable deposit of carbon (0g, 00265) to suppose them in such quantities that their presence could not fail to be detected in the analysis.

"From these results, the cementation of iron by carbonic oxide cannot be doubtful, and the conditions in which it has been made have permitted the author to ascertain if nitrogen is indispensable to the production of steel. I caused a current of hydrogen to pass for a very long time over iron reduced to excessively fine sheets, and properly heated to remove from it any nitrogen that it might contain, as indicated by M. Fremy.

"This iron after this long treatment was heated during three hours in an atmosphere of carbonic oxide: carbonic acid was disengaged, and the iron was converted into steel. As the operation was made under shelter from the external atmosphere, and the carbonic oxide employed contained no nitrogen, I believe it safe to conclude from this cementation, as well as from that by the diamond, which I have heretofore communicated, that nitrogen is not indispensable either to the production or the constitution of steel."

CORRESPONDENCE.

THOMPSON'S ELECTRO-MAGNETIC INDUCTION MACHINE.

To the Editor of the Telegraphic Journal.

Sir,—I read with much interest what is said or advertised in your last number about Thompson's electro-magnetic induction machine; but I doubt whether Mr. Thompson has ever succeeded in obtaining electric light with his machine. It is well known that not only *tension* is required for obtaining electric light, but *quantity* at the same time, and that the induction machine does not create electricity, but simply converts quantity into tension. The only light to be obtained from the induction machine is that produced in the vacuum, and especially in Geissler's tubes, which I found to be about six times less than that of a small wax candle. That light will be increased, very likely, with the improvements made in the induction machine, but will never enter into comparison with that of the voltaic arc, obtained with sixty Grove cells.—Yours sincerely,

Paris, November 13, 1864. Un Abonné.

BONELLI'S TELEGRAPH COMPANY.

To the Editor of the Telegraphic Journal.

Sir,—A few months ago we were promised cheap telegraphy by the promoters of the Bonelli Electric Telegraph Company. Can you or any of your readers inform me what has become of this mightily-puffed project? Has it proved a failure? Has it gone the way of many other latter-day schemes? Why, sir, the Bonelli printing telegraph was talked of in all parts of the country. Every newspaper, pretty nearly, in the kingdom contained a description of the instrument, and an invitation to the public to subscribe capital to the company. Surely t'brass was raised; if not, a quantity o' siller was sunken in the attempt to establish a rival to existing telegraph companies. In the latter case, will the shareholders have to pay the piper, or were they guaranteed against any loss, in the event of the endeavour to form a company falling through?—Yours truly,

Clapham, Nov. 16, 1864. J. Whittaker.

Current Literature.—*Herapath's Railway Journal* of the 12th November, contains the report of a meeting of the Universal Private Telegraph Company, held on the 24th August, which appeared in our columns nearly three months since. Our contemporary is perhaps better late than never.

TELEGRAPHIC NEWS.

Telegraphy in New South Wales.—Plans have been submitted to the Legislature for a new telegraph and post-office at Tamworth. Plans are also prepared for a telegraph station at Wagga Wagga.

Telegraphic Progress.—The Russian telegraph from Omsk to Irkoutsk is completed—a distance of 3,285 miles. This renders the great telegraphic chain between the most westerly part of Great Britain and the most easterly part of Asia complete.

The Directors of the Central Pacific Railway Company state in their annual report that they have thirty-one miles of railroad and telegraph now in operation, and that their average monthly receipts since June have been over 16,000 dollars, while their expenses have not exceeded 3,000 dollars.

Progress in Queensland.—Mr. G. E. Dalrymple, the commander of an expedition sent out to explore the north-eastern coast of Australia, sums up the results of his explorations of the Herbert with the following remarks: —Stations have already spread down the Flinders to within 100 miles of the Gulf of Carpentaria, and will soon, by reaching its shores, give protection to the telegraphic line to India, viâ Timor and Java.

The Anglo-Indian Telegraph.—By a telegram received through Reuter's agency, dated Constantinople, 11th November (11.45 p.m.), we learn that a convention has been concluded between the British Government and the Porte for the working of the Anglo-Indian telegraph. A Turkish office will be established at Fao, where the land and submarine lines meet. One wire from Constantinople will be exclusively used for Indian messages. The tariff for a single message from Constantinople to Fao will be 22 francs 50 cents.

Theft of Telegraph Stamps.—At the Leeds Town-hall on the 8th instant, Michael Jordan was charged with having, on the 21st July last, broken into the offices of Messrs. Fowler, Steam Plough Works, Hunslet, and stolen the sum of £4 10s. in cash, and a quantity of telegraph stamps, the numbers of which had been taken when they were sold by Mr. Nelson, the local manager of the Electric Telegraph Company. They were presented at the company's office by the prisoner, and were recognised by Mr. Nelson, who immediately went to the gentleman who, as Jordan stated, had sent him to get them exchanged. The prisoner succeeded in escaping while Mr. Nelson was making inquiries. He was afterwards apprehended, and committed for trial.

United Kingdom Telegraph Company.—Mr. Andrews, secretary to the above company, writes the *Times* as follows:—"Sir,—A letter, signed 'D. W.,' appeared in your impression of the 5th instant, complaining of the non-delivery by this company of a telegraphic message. No particulars being given, some time has been necessarily employed in tracing the complaint, and the directors have just had the subject under their careful consideration. As it is impossible to secure an absolute perfectibility of working, and an equally absolute immunity from complaints, it would have been, perhaps, scarcely necessary to reply to your correspondent, were it not that his deductions from the one cause embrace the conclusion that this is 'a very badly conducted telegraph company.' The publication of this remark in your columns gives it its only importance. The directors have had the complaints gone through for the last month of entry, and they find that the average is exactly one complaint to 1,729 messages. To complete this number of transactions through the delicate machinery of the electric telegraph, with but one complaint, is, I submit, not altogether a discreditable performance. The public generally, judging from the increase in our business, does not appear to be of 'D. W.'s' opinion. For the four weeks ending the 24th October last year, 25,983 messages were received at our counters for transmission; for the four corresponding weeks this year, 50,189 messages; and the present business of the company shows a considerable increase even in these latter numbers."

MISCELLANEA.

A Company for Electric Light Fishing.—A company for deep-sea fishing, with the aid of electric light, has been founded at Dunkirk.

Money Order System in America.—The postal money order system, which has proved of so much service to the commercial community of this country, was brought into use on the other side of the Atlantic on the 1st November, and so useful has it been found already, that the *Philadelphia Inquirer* affirms that it "will soon be discovered to be indispensable in the management of business in different sections of the country."

The Proposed Exhibition at Copenhagen.—For some time past a very strong desire has been expressed that an exhibition of the manufactures and art of the Scandinavian States should be held in Copenhagen, of the same kind as those which have been held in London and elsewhere. A committee for carrying out this project was appointed, of which Prince Oscar was selected president, whose report has just been published in which it is proposed "That an exhibition of the products of the three Scandinavian States—Sweden, Norway, and Denmark—should take place in the summer of 1866, and that for that purpose a crystal palace should be constructed at the expense of the state and of the capital."

THOMPSON'S ELECTRO-MAGNETIC APPARATUS.—An abridgment of Mr. Thompson's specification will, doubtless, prove interesting to our readers. This invention has for its object the so arranging electro-magnetic induction machines as to make them suitable for use for ordinary telegraphic purposes, the machine itself making and breaking the primary battery circuit, and also working a commutator, so as to lead all the positive induced currents to one conducting wire or channel, and all the negative induced currents to another conducting wire or channel; hence, when these wires or channels are connected at a distance, a current which is practically continuous flows through them, and this current may be used for telegraphic purposes, just as a direct battery current is now commonly employed. The patentee uses two sets of induction coils, arranged end to end, and at a short distance apart. By preference he employs two, or an even number of coils in each set; but this is not essential, as a single coil may be used in place of a set. If two coils be used in each set, he connects their soft cores together at their outer ends by a permanent armature; if several coils be used in each set, he couples their cores together in pairs by permanent armatures. Between the two sets of coils he arranges an oscillating armature, which, by a rod connected with it, or otherwise, is made, as it moves to and fro, to send the primary current first into the primary wires of one set of induction coils, and then into the primary wires of the other set of coils. The oscillating armature also moves the commutator, by which the currents induced in the secondary wire of the induction coils, which are reversed by the changing the primary current from one set of coils to the other, are, nevertheless, caused to pass from the machine always in the same direction, the contacts being changed by the commutator to compensate for the changes in the direction of the induced currents. Thus it will be seen that both the primary and secondary currents are directed by the machine itself, so that the machine is self-acting, for as soon as the primary current is allowed to flow, one set of induction coils is thereby magnetised, and the oscillating armature is drawn towards this set; then, as this motion cuts off the primary current from the first set of coils, and turns it over to the other set, those in turn draw back the oscillating armature, which is thus kept in constant motion so long as the primary current is on.

THE NOVEMBER STAR SHOWERS.—Mr. H. Newton has commenced in the *American Journal of Science* the printing of the original accounts, in various languages, of the displays in former times of what may be considered the predecessors of the great exhibition of shooting stars on the morning of November 13, 1833, which afford data for the determination of the length of the annual period, and the fifty-three year cycle. They also furnish, he says, "additional arguments (if such arguments are needed) for the theory that the shooting stars are small bodies moving originally each in its own orbit, until they come into the earth's atmosphere, were they burn for an instant and are dissipated into smoke or dust. They show that the time during which the swarm of bodies furnishing the November meteors revolve about the sun must be limited to one of five accurately-determined periods, one of which is more probable than the others. They will serve to direct future observation, and perhaps verify or correct such hypotheses as have been or may be presented." M. Baillard, in commenting on Mr. Newton's calculations, says that the group of bodies which give rise to the November shooting stars may be preceded or followed by a cloud of dust excessively fine, which, under the influence of the magnetic pole, may give rise to an aurora borealis.

A NEW USE FOR GUTTA-PERCHA.—Gutta-percha is now used to protect the feet of horses from tenderness and slipping. It is first cut into small pieces and softened with hot water, then mixed with half its weight of powdered sal ammoniac, and the mixture melted in a tinned saucepan over a gentle fire, keeping it well stirred. When required for use, it is melted in a glue-pot, the hoof is scraped clean, and the mixture is applied with a knife.

THE EARLIEST CALENDAR.—The first astronomical almanack published in Europe was entitled "Kalendarium Novum for 1475," the author and publisher of which was Johann Müller, the German mathematician.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2767. J. Henshaw, an improved method of and apparatus for signalling and giving alarm on railways.
2813. E. Richardson, improvements in means and apparatus for producing or effecting fog signals.
2826. C. Cotton and W. Nunn, improvements in apparatus for facilitating communication between passengers and guards of railway trains.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2616. J. Scarisbrick, improvements in apparatus for signalling on railway trains.
2634. W. Clark, improvements in apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general.—A communication.
2638. J. Tate, an improvement or improvements in signalling on railways.

PATENTS SEALED.

1234. W. Reid, improvements in apparatus used for testing the insulation of electric telegraph wires or conductors.
1412. H. A. Bonneville, improvements in telegraphic printing apparatus.—A communication.

PATENTS WHICH HAVE BECOME VOID.

2725. W. Cook and H. Cook, improvements in printing telegraphs.
2784. G. T. Bousfield, improvements in electro-plating or depositing metals.—A communication.

NOTICES TO PROCEED.

1973. P. A. J. Dujardin, improvements in electric telegraphs.
2463. F. W. Shields, improvements in telegraphic posts.

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TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	104 to 107	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	$\frac{3}{8}$ to [illegible]	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{3}{4}$ to $\frac{1}{4}$ dis.	—

TO CORRESPONDENTS.

R. S.—Thanks. Please favour us with a more definite address.

QUERIST.—Take a solution of nitro-muriate of gold, and add to a gill of it a pint of alcohol, then immerse the plate for about fifteen minutes.

AGENT.—The property of the United Kingdom Telegraph Company, lately destroyed by a gas explosion at Liverpool, was not insured.

J. RAWLINSON.—The paper to which you refer appeared in No. 43 of the *Telegraphic Journal*.

A. WHITE.—Very little information is procurable as to the manufacture of the Atlantic cable, but we believe the work is progressing to the satisfaction of the electrician to the Atlantic Telegraph Company.

ALPHA.—The application of magnetism to the tyres of the wheels of locomotives and carriages on railways, in order to affect their impetus, has been tried, and resulted in failure.

J. WHITTAKER.—We are unable to give you the information required. The offices of the Boncili Telegraph Company are situate in John-street, Adelphi, W.C. Address the secretary.

ENQUIRER.—The oxidation of iron does not take place in pure oxygen. The presence of other substances is indispensable to the process, which may be described as the combining of two atoms of oxygen with seven atoms of iron in an atmosphere affected by carbonic acid and water.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

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Half ditto	2	10	0	Four lines and under (single col.)	0	3	6

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THE TELEGRAPHIC JOURNAL.

Vol. II. No. 48.—November 26, 1864.

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ON RAILWAY ELECTRIC SIGNALLING.

By W. H. Preece, Assoc. Inst. C.E.

(*Continued from page* 242.)

Having established the bell communication between the two stations, the next requirement demanded of us is that there shall be one signal to rule and protect the "down line," and another signal to rule and protect the "up line."

The fundamental principle of the "block" system is that no two following trains shall be allowed to proceed in the same direction upon the same section of line at the same time, and therefore a danger-signal must be exhibited and maintained at the station from which a train has departed, until it has been cleared out of the section of line over which it is travelling. To do this effectually this signal must be under the sole control of the signalman towards whom the train is approaching; and no accident, mechanical or electrical, must be allowed to remove this signal until the train has arrived.

The signal which is most extensively used upon other railways to effect this important demand is the deflection of the ordinary needle that is employed generally for telegraphic purposes. The needle pointing to one side signifies "*Line clear,*" to the other side "*Line blocked.*" As this is manifestly insufficient for the purpose numerous endeavours have been made to improve its uncertain and indecisive indications. One half of the face has been painted *white*, the other half *red*. The needle has been loaded with cards bearing the printed words "*Train on Line*" on a red ground, and "*Line clear*" on a white ground, which are brought alternately to view through an opening on the front of the instrument. Now, the signal which I use to denote "danger" and "all clear" to the signal man is the same as that exhibited to the driver. The actual instruments themselves are, of course, not the same: the signalman's signal is in his box, the driver's on the line; but the nature and design of the signal is similar. Thus, if the raising and lowering of a semaphore arm be used on the line to guide the driver, a miniature semaphore arm is used in the box to instruct the signalman. If the exhibition and obscuration of a disc or bar is used out-of-doors, a small disc or bar precisely similar is used indoors. If it were possible to work an out-door signal by electricity the system would be perfect; but inasmuch as the power of electricity is but circumscribed, we have not yet attained that production of force which is sufficient to actuate with any degree of certainty our exposed signals. We are, therefore, compelled to adopt the nearest approach to this, and to rely upon small electrical instruments, which direct the signalman how to exhibit his out-door signals by displaying the signals which they themselves ought to give.

The semaphore instrument which I employ is shown in the following sketches (Figs. 4 and 5). The "danger" and "all clear" signals are both illustrated. If necessary the "caution" signal could easily be added; but as this signal is gradually being abandoned on most lines, and is quite useless, if not dangerous, in the "block" system, its introduction into electric signals has not been considered advisable.

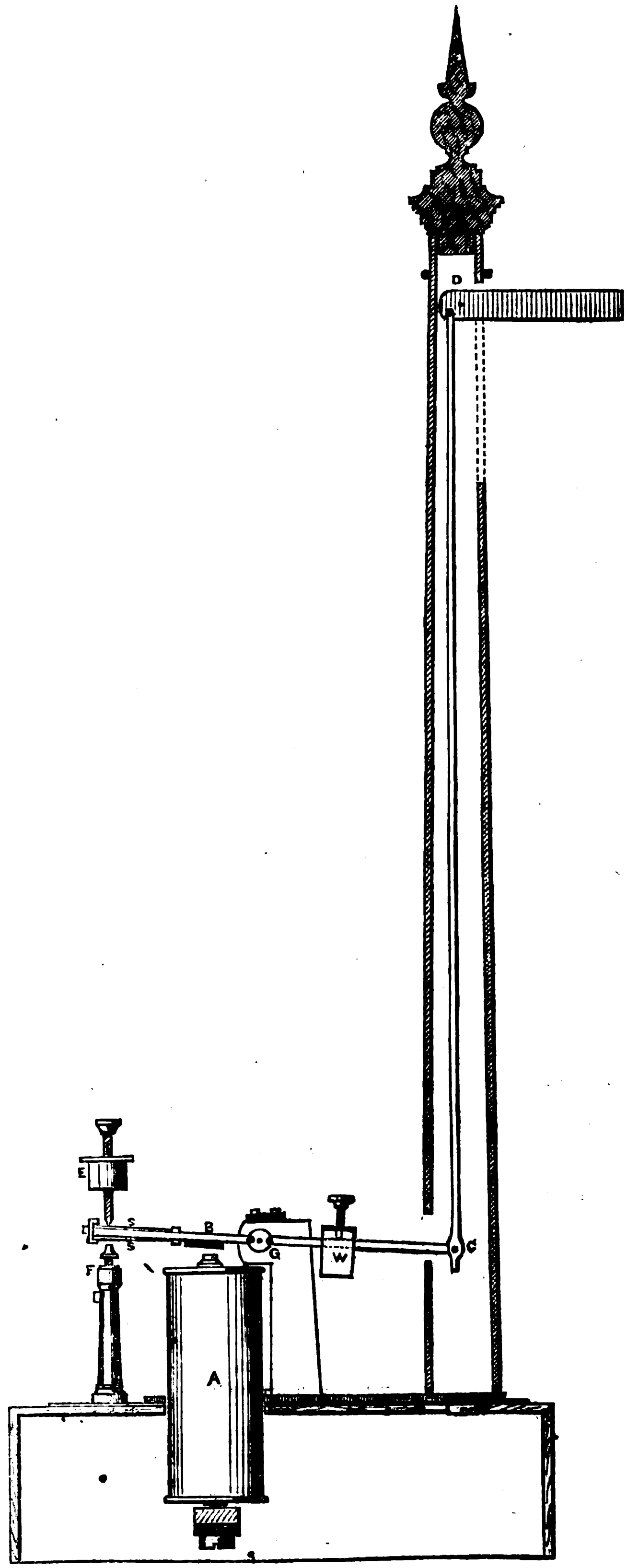


Fig. 4.

The interior mechanism of the semaphore is shown in Fig. 4, which is a complete section of one side to the scale of one-third of the full-sized instrument, but with the position of the post and arm turned sideways to make the illustrations of the working parts more clear. Fig. 5 is an end view and elevation, with the arm down and position unaltered.

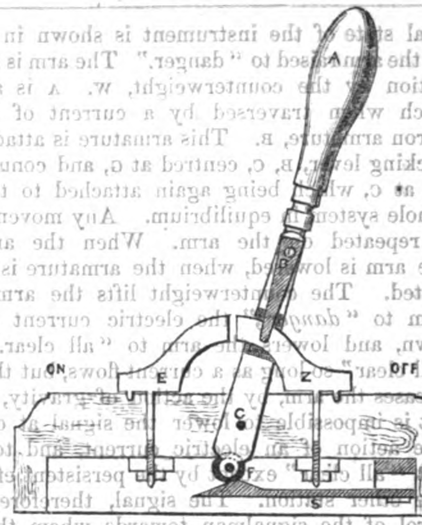


Fig. 6.

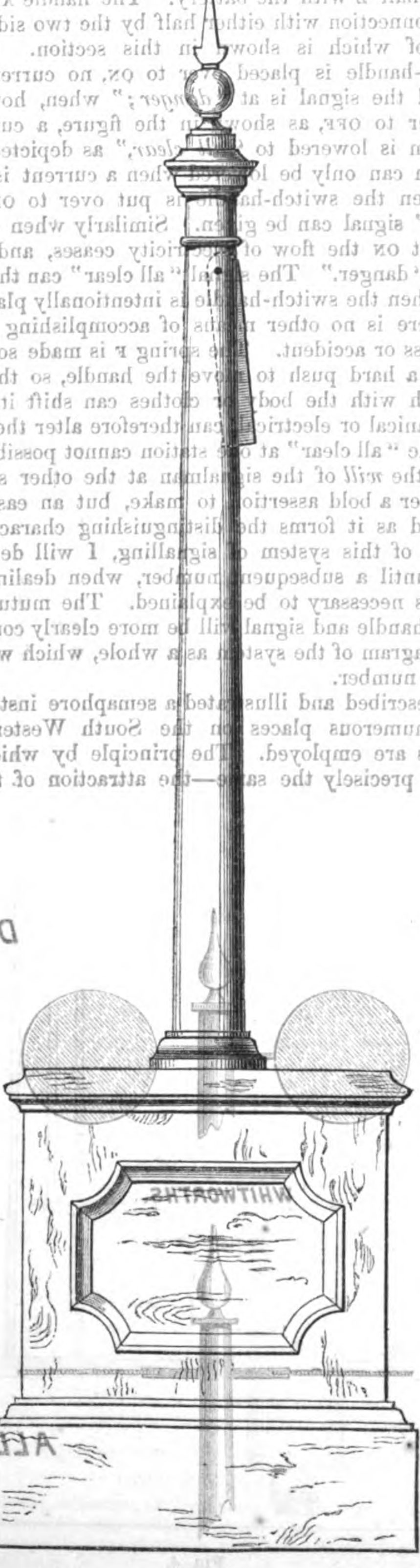
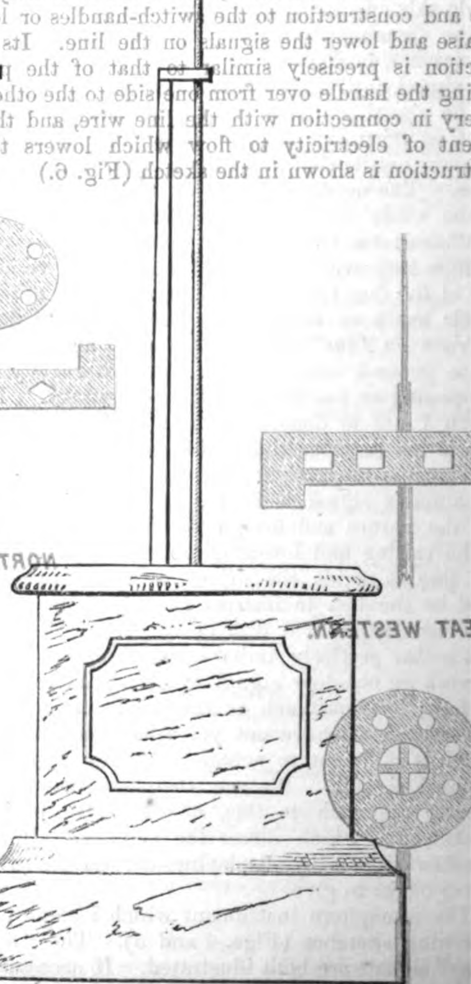


Fig. 5.



SOUTH WESTERN.

The normal state of the instrument is shown in the figure (Fig. 4) with the arm raised to "danger." The arm is maintained in that position by the counterweight, W. A is an electro-magnet, which when traversed by a current of electricity, attracts the iron armature, B. This armature is attached to the end of the rocking lever, B, C, centred at G, and connected with the rod, C, D, at C, which being again attached to the arm, D, leaves the whole system in equilibrium. Any movement of the armature is repeated on the arm. When the armature is depressed the arm is lowered, when the armature is raised the arm is elevated. The counterweight lifts the armature and raises the arm to "*danger*;" the electric current draws the armature down, and lowers the arm to "all clear." It will remain at "all clear" so long as a current flows, but the moment the current ceases the arm, by the action of gravity, flies up to "danger." It is impossible to lower the signal at one station except by the action of an electric current, and to maintain that signal at "all clear" except by the persistent effect of the battery at the other station. The signal, therefore, is under the sole control of the signalman towards whom the train is approaching.

It will be seen that the same principle which produces a blow upon the bell lowers the semaphore arm to "all clear." The current of electricity which flows through the wire of the electro-magnet converts the iron core into a magnet, and exerts precisely the same action upon the rocking lever, B, C, that a pull or strain of a signal wire does upon the rocking lever of a signal post. The counterweight, W, when the current ceases, restores the arm to "danger," as it does in ordinary line signals.

The instrument which is employed to raise and lower the signal is called a "Switch," from the similarity of its appearance and construction to the switch-handles or levers employed to raise and lower the signals on the line. Its electrical construction is precisely similar to that of the piston-key. By moving the handle over from one side to the other, it places the battery in connection with the line wire, and thereby causes a current of electricity to flow which lowers the signal. Its construction is shown in the sketch (Fig. 6.)

A is a handle which moves freely upon the centre C, S is a stout spring, with a double inclined plane, which, by pressing firmly on the friction roller F, maintains the handle in position ("blocks" it over) when it has been so moved. The semicircular piece of brass E Z is divided in the centre, to insulate the one half from the other. The half E is in connection with the earth—the half Z with the battery. The handle A is placed in electrical connection with either half by the two side-springs B, only one of which is shown in this section. Now when the switch-handle is placed over to ON, no current is transmitted, and the signal is at "*danger;*" when, however, it is pushed over to OFF, as shown in the figure, a current flows, and the arm is lowered to "*all clear*," as depicted in Fig. 5. As the arm can only be lowered when a current is flowing, it is only when the switch-handle is put over to OFF that the "all clear" signal can be given. Similarly when the switch-handle is at ON the flow of electricity ceases, and the signal must be at "danger." The signal "all clear" can therefore only be given when the switch-handle is intentionally placed over to off, and there is no other means of accomplishing this object by wilfulness or accident. The spring F is made so stout that it requires a hard push to move the handle, so that no accidental touch with the body or clothes can shift it. No accident, mechanical or electrical, can therefore alter the "danger" signal. The "all clear" at one station cannot possibly be given except by the *will* of the signalman at the other station. As this is rather a bold assertion to make, but an easy matter to explain, and as it forms the distinguishing characteristic and chief merit of this system of signalling, I will defer its consideration until a subsequent number, when dealing with the other points necessary to be explained. The mutual action of the switch-handle and signal will be more clearly comprehended from the diagram of the system as a whole, which will be given in the next number.

I have described and illustrated a semaphore instrument, but there are numerous places on the South Western Railway where discs are employed. The principle by which they are actuated is precisely the same—the attraction of the electro-

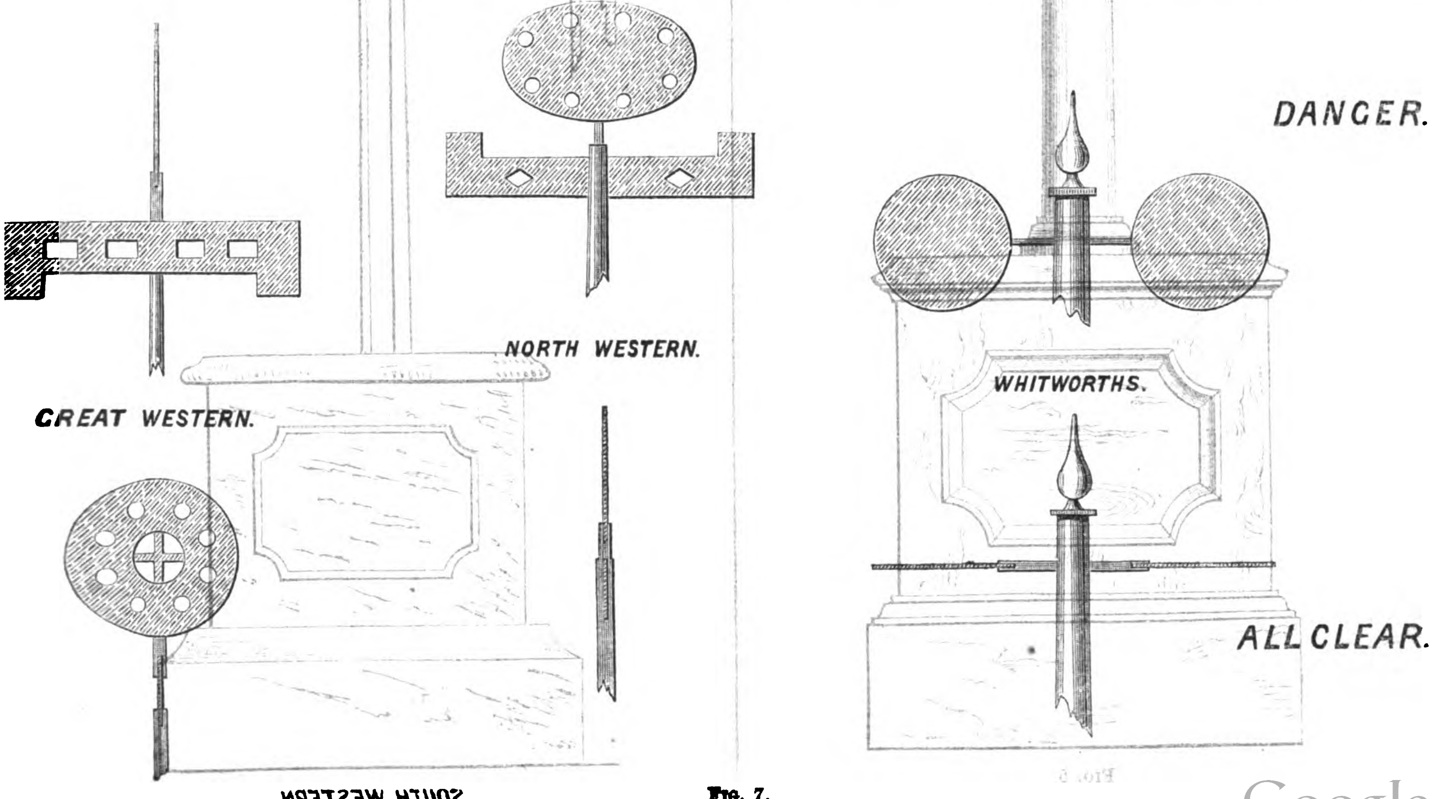


FIG. 7.

magnet is simply made to do what the strain of the wire effects upon the line. The sketches (Fig. 7) on preceding pages will fully explain this particular instrument. Gravity maintains the signal at "Danger"—the electric current takes it off. I give the sketch of an instrument working the South Western half-moon discs to the same scale as that of the semaphore, and the various discs and bars of different companies side by side. In every other respect they work the same as the semaphore.

(To be continued.)

ELECTRICAL STANDARDS AND ELECTRICAL MEASUREMENTS.

In practically dealing with dynamic electricity, the want of a standard of measure has been long felt by every one. I, with many others, have vainly hoped that ere this our learned men, who are seeking to establish such a standard, would have given us one. Either it is a difficult problem to solve, or else our *savans* do not give it the study it deserves. It is a thing requiring care, doubtless; but how it should have puzzled thirteen learned gentlemen for years, and is still unsolved by them, is not easy to understand, seeing that we find such names amongst them as Wheatstone, Varley, and Bright. One begins to think that names do not stand for much. Yet with the public these names stand for all that is, or ever can be, known in electricity. I recollect once hearing some advice given to a village schoolmaster, who was about to send out cards of what he engaged to teach. His subjects were "the three immortal R's." "Put down Latin, Greek, and Hebrew," said a gentleman whom he was consulting. "But I cannot teach these," he said. "Then charge them so high that nobody can afford to ask you; and if you can *make a show of knowing something, the people will give you credit for all that you pretend to.*" It was done, and ever after the schoolmaster was thought to be a most learned man.

It is a most mysterious thing this electricity; speaking after our *savans*, it is by turns a fluid and a force, and then again a——. Really I am puzzled; but I will quote from their report:—"Here, then, is an absolute or coherent system, starting from an effect produced by electricity when at rest." An effect, I suppose, is something done; and to be at rest is to be doing nothing. So that we have here stated that electricity has done something at the time it was doing nothing! And we are told further on that this something-nothing is work, and that it was Thomson and Helmholtz who introduced *that* into the system. Immortal Thomson and Helmholtz!

In the next paragraph we are told that the system above referred to is not that which will be found most generally useful; and to supply a system that will, we have this equation given

$$f = \frac{C L m}{k^2}.*$$

And it is said, that "from this equation it follows that the unit length of the unit current must produce the unit force on a unit pole at the unit distance." Well, that is clear enough to a certainty. But we have some more profound conclusions drawn from the equations, which embody the systems referred to. The equations are these—

$$C = \frac{E}{R}, Q = C t, W = C^2 R t, F = \frac{Q}{d^2}$$

C = current, E = electro-motive force, R = resistance, Q = quantity, W = work, t = time, F = force exerted between two charged conductors, and d = distance of those conductors.

Then follows the summation of all the relations derived therefrom:—"The unit current conveys a unit quantity of electricity through the circuit in a unit of time. The unit current in a conductor of unit resistance produces an effect equivalent to the unit of work in the unit of time. The unit current will be produced in a circuit of unit resistance by the unit electromotive force. The unit current flowing through a conductor of unit length will exert the unit force on a unit pole at a unit distance."

After all, "your committee" has not wasted its time, when it has discovered such weighty truths as these. Weighty truths—aye, truisms that there is no disputing!

The second part of the report treats of "the measurement of magnetic phenomena."

After stating that $f = \frac{m m_1}{D^2}$ we are told right off that "the dimensions of the unit magnetic pole are $\frac{L^{\frac{3}{2}} M^{\frac{1}{2}}}{T}$." But there is no hint at all why these are the dimensions of a unit pole, only at the other side of the leaf we are told that it is quite clear that it is so. No doubt it is! We will take it for granted; and then, when translated into ordinary language, the dimensions of a unit magnetic pole are these:—The square root of the cube of some length multiplied into the square root of some mass divided by some time or other. I should think it would take an expert to make a unit magnetic pole, even though he had these dimensions.

Again, "$f = m H$; therefore, the magnetic field of unit intensity will be that which acts with unit force on the unit pole." And the dimensions of the unit of magnetic intensity are $\frac{M^{\frac{1}{2}}}{L^{\frac{1}{2}} T}$. That is the square root of some mass divided by the product of the square root of some length into some time.

Further on, in treating of magnetic moment, we are told that "in reality we can never have a single pole entirely free, or disconnected from its opposite pole." In other words, we can never have a bar of steel with only one extremity, which is quite true, and also very obvious; but I must say it reminds me of my cousin from Cork.

Hitherto the truths enunciated in this report have been overwhelmingly convincing, and we have joyfully received them; but here is something difficult to assent to. This is it:—"When certain bodies, such as soft iron, &c., are placed in the magnetic field, they become magnetized by induction, so that the intensity of magnetization is (except when great) nearly proportionate to the intensity of the field."

I think Faraday has shown, and any one can now show, that the lines of force are diverted from all sides when soft iron is present to pass through it, without any exception. The above is put forth as a definition of the co-efficient of magnetic induction; but if it shows anything, I should say it shows magnetic conduction. Besides, what a definition! with an *almost* and an *exception* in it.

Then we are told diamagnetics, such as bismuth, are magnetized in an opposite direction to that of the field. As if bismuth could be magnetized at all in the sense that iron is magnetized; and if it cannot, then it is a simple abuse of words to talk of the magnetization of a diamagnetic.

The third part treats of the measurement of electrical phenomena; but first we are vouchsafed the definitions of current, quantity, electro-motive force, resistance. The which rejoiced us exceedingly, and we said in our heart, now we shall have solid ground whereon at least to begin; but it was a delusion, as the sequel will show:—

"*Meaning of the words 'Electric Quantity.'*—When two light conducting bodies are connected with the same pole of a voltaic battery, while the other pole is connected with the earth, they may be observed to repel one another. The two poles produce equal and similar effects. When the two bodies are connected with opposite poles, they attract one another. Bodies, when in a condition to exert this peculiar force one on the other, are said to be electrified, or charged with electricity. These words are mere names given to a peculiar condition of matter. If a piece of glass and a piece of resin are rubbed together, the glass will be found to be in the same condition as an insulated body connected with the copper pole of the battery, and the resin

* f = force exerted on the pole of a magnetic needle, m = strength of the pole, L = length of wire surrounding it, and k = radius of the coil.

in the same condition as the body connected with the zinc pole of the battery. The former is said to be positively, and the latter negatively electrified. The propriety of this antithesis will soon appear. The force with which one electrified body acts on another, even at a constant distance, varies with different circumstances. When the force between the two bodies at a constant distance, and separated by air, is observed to increase, it is said to be due to an increase in the quantity of electricity; and the quantity at any spot is defined as proportional to the force with which it acts through air on some other constant quantity at a distance. If two bodies, charged each with a given quantity of electricity, are incorporated, the single body thus composed will be charged with the sum of the two quantities. It is this fact which justifies the use of the word 'quantity.'

"Thus the quality in virtue of which a body exerts the peculiar force described is called electricity, and its quantity is measured (*cæteris paribus*) by measuring force.

"The quantity thus defined produced on two similar balls similarly circumstanced, but connected with opposite poles of a voltaic battery, is equal, but opposite; so that the sum of these two equal and opposite quantities is zero; hence the conception of positive and negative quantities.

"In speaking of a quantity of electricity, we need not conceive it as a separate thing, or entity distinct from ponderable matter, any more than in speaking of sound we conceive it as having a distinct existence. Still it is convenient to speak of the intensity or velocity of sound to avoid tedious circumlocution; and quite similarly we may speak of electricity, without for a moment imagining that any real electric fluid exists."

There is a definition for you! Does it define anything? does it explain anything? It would be difficult to point out what. "Your committee" is most infelicitous in its definitions. It begins by telling us that when two currents of electricity are flowing through two light conductors from the same pole of a battery, these conductors repel each other, and if to different poles they attract, and it is assumed that this force is in proportion to the quantity of electricity flowing through the wires. Then, after one or two questions have been answered that no sane person would think of asking, the paragraph ends with the sum substance and pith of this part of the definition—namely, "that if two bodies, charged each with a given quantity of electricity, are incorporated, the single body thus composed will be charged with the sum of the two quantities." "It is this fact which justifies the use of the word 'quantity.'" There is a conclusion for you. Does it not remind you of Tom Taylor's conclusion?—"And this accounts for the milk in the cocoa-nut!"

Well, now, suppose it does justify the *use* of the word quantity—is "your committee" justified in giving it as part of the meaning of *the word quantity?*

The only thing which even has a hint in it of the meaning of the word quantity is, *that the force exerted between two conductors having currents flowing through them is in proportion to the quantity of electricity present.*

That seems to be the meaning which "your committee" intended to convey, at least they assume to have done it somehow; for they go on to tell us some other marvellous things about this quantity—namely, that the quantities in the two opposite poles of a battery are equal, but opposite, so that when these two quantities are added together there is no quantity at all, or, as they have it, the sum of the quantities is zero. Then follows one of "your committee's" conclusions, "hence the conception of positive and negative quantities."

I would ask—Is "your committee" poking fun? What is a negative quantity? Are they dreaming in algebra? I suppose quantity means a positive measure of some magnitude, if it means anything at all; but a negative quantity—what is it? A measure of a certain magnitude, which is no magnitude, and nothing at all. Where am I? "Your committee" has fairly set me upon my head, and they appear to me to be all upside-down, too. I am afraid, if we go on at this rate, we shall all have to go to Bedlam together.

But this is not all. They tell us that we need not conceive of quantity of electricity as a separate thing, or entity distinct from ponderable matter, any more than in speaking of sound we conceive it as having a distinct existence. But we *do* conceive of sound as distinct from ponderable matter. It is the motion of ponderable matter made sensible to us by our ears; and surely the motion of a stone is no part of the stone.

Now comes the meaning of the words "electric current," according to "your committee":—

"When two balls charged by the opposite poles of a battery, with opposite and equal quantities of electricity, are joined by a conductor, they lose in a very short time their peculiar properties, and assume a neutral condition intermediate between the positive and negative states, exhibiting no electrical symptoms whatever, and hence described as unelectrified, or containing no electricity. But during the first moment of their junction, the conductor is found to possess certain new and peculiar properties: any one part of the conductor exerts a force upon any other part of the conductor; it exerts a force on any magnet in the neighbourhood; and if any part of the conductor be formed by one of those compound bodies called electrolytes, a certain portion of this body will be decomposed. These peculiar effects are said to be due to a current of electricity in the conductor. The positive quantity or excess is conceived as flowing into the deficiency caused by the negative quantity; so that the whole combination is reduced to the neutral condition. This neutral condition is similar to that of the earth where the experiment is tried. If the balls are continually recharged by the battery, and discharged or neutralized by the wire, a rapid succession of the so-called currents will be sent; and it is found that the force with which a magnet is deflected by this rapid succession of currents is proportional (*cæteris paribus*) to the quantity of electricity passed through the conductor or neutralized per second; it is also found that the amount of chemical action, measured by the weights of the bodies decomposed, is proportional to the same quantity. The currents just described are intermittent; but a wire or conductor, used simply to join the two poles of a battery, acquires permanently the same properties as when used to discharge the balls as above with great rapidity; and the greater the rapidity with which the balls are discharged, the more perfect the similarity of the condition of the wire in the two cases. The wire in the latter case is therefore said to convey a permanent current of electricity, the magnitude or strength of which is defined as proportional to the quantity conveyed per second."

What does "your committee" mean by all that stuff, think you? I have no doubt you can guess, if your head is not stuffed with learned nonsense; because you know they began by saying that they would explain the meaning of the words "electric current." Let me try my hand at a definition. *An electric current is the motion produced by the electric force in a conductor.* I think that is what they mean, if they did not hacker so.

"*Meaning of the words 'Electro-motive Force.'*—Hitherto we have spoken simply of statical effects; but it is found that a current of electricity, as above defined, cannot exist without effecting work or its equivalent. Thus it either heats the conductor, or raises a weight, or magnetizes soft iron, or effects chemical decomposition; in fine, in some shape it effects work, and this work bears a definite relation to the current. Work done presupposes a force in action. The immediate force producing a current, or, in other words, causing the transfer of a certain quantity of electricity, is called an electro-motive force. This force is necessarily assumed as ultimately due to that part of a circuit where a 'degradation,' or consumption of energy takes place; thus we speak of the electro-motive force of the voltaic or thermo-electric couple; but the term is also used independently of the source of power, to express the fact that, however caused, a certain force tending to do work by setting electricity in motion does, under certain circumstances, exist between two points of a conductor, or between two separate bodies. But equal quantities of electricity transferred in a given time do not necessarily or usually produce equal amounts of work; and the electro-motive force between two points, the proximate cause of the work, is defined as proportional to the amount of work done between those points when a given quantity of electricity is transferred from one point to another. Thus if, with equal currents in two distinct conductors, the work done in the one is double that done in the second in the same time, the electro-motive force in the first case is said to be double that in the second; but if the work done in two circuits is found strictly proportional to the two currents, the electro-motive force acting on the two currents is said to be the same. Defined in this way, the electro-motive force of a voltaic battery is found to be constant so long as the materials of which it is formed remain in a similar or constant condition. The above definitions, in mathematical language, give $W = E C t$, or

$$E = \frac{W}{C t}, \quad \ldots \ldots \ldots \ldots \quad (5)$$

where E is the electro-motive force, and W the work done. Thus the electro-motive force producing a current in a conductor is equal to the ratio between the work done in the unit of time and the current effecting the work. This conception of the relations of work, electro-motive force, current, and quantity, will be aided by the following analogy:—A quantity of electricity may be compared to a quantity or given mass of water; currents of water in pipes in which equal quantities passed each spot in equal times would then correspond to equal currents of electricity; electro-motive force would correspond to the head of water producing the current. Thus if, with two pipes conveying equal currents, the head forcing the water through the first was double that forcing it through the second, the work done by the water in flowing through the first pipe would necessarily be

twice that done by the water in the second pipe; but if twice as much water passed through the first pipe as passed through the second, the work done by water in the first pipe would again be doubled. This corresponds exactly with the increase of work done by the electrical current when the electromotive force is doubled, and when the quantity is doubled."

It is stated in the former part of this definition that the electro-motive force is that which causes a transfer of a quantity of electricity. Then we are told that the electro-motive force is that which does work. And immediately after we are told that equal quantities of electricity transferred in a given time do not necessarily or usually produce equal amounts of work. But how is this? Equal amounts of electro-motive force, we are told, do equal amounts of work, and it is this same electromotive force which causes the transfer of quantities of electricity, and I suppose it will take equal electro-motive forces to cause the transfer of equal quantities of electricity; yet these equal quantities do not do equal amounts of work. Surely "your committee" has a twist in its rational faculty.

To illustrate this most contradictory of definitions, we have a hydrostatic analogy given. A quantity of electricity is compared to a quantity or given mass of water. Currents of water in pipes correspond to quantities of electricity. Equal currents in equal times correspond to equal quantities of electricity. Electro-motive force corresponds to head of water. Then two pipes are supposed to convey equal currents in equal times; but one of them is supposed to have double the head or pressure that the other has. Then it is said that the work done in the first pipe will be double the work done in the second. Now, what is a current? I suppose the running of something. And for currents to be really equal, not only must the rate of that running be equal, but the quantity of that which runs must also be equal—that is, they must be equal in mass and velocity; under any other conditions no two currents can be equal. Well, then, what does "your committee" mean when they begin by supposing two currents equal, but one to have twice the head of the other? how is it possible? How can the work be double in one what it is in the other, if the currents be equal? Neither can the two currents be equal in any respect under these conditions. The only thing possible is, that the quantities delivered in equal times may be equal, if the pipe with twice the head have half the sectional area. But the currents in no respect would be equal; only the effects produced by them would be equal. Still, "your committee" is not content with this; they must make it more absurd. They say, "But if twice as much passed through the pipe that has half the pressure, then the work done would be equal." I once heard an Irish reaper ask, "Shure, sor, is this a hill all the way to the top?" "Of course, Paddy." "Thin, bi mee sowl, I wish 't had been half of it the other way; I could ha' clum it as asy agin." I should think Paddy could have settled this hydraulic paradox.

By "your committee's" definition, then, electro-motive force is that which transfers a quantity; also that which does, or is proportionate to the work done; therefore, quantity and work must be proportionate; but "your committee" says it is not necessarily so, yet they tell us in their definition of quantity that it is proportionate to the force exerted between two conductors conveying such quantity.

Then, after "your committee" imagine they have defined electro-motive force, they say:—"Thus to recapitulate, the quality of a battery, in virtue of which it tends to do work by the transfer of electricity from one point to another, is called its electro-motive force, and this force is measured by measuring the work done during the transfer of a given quantity of electricity between those points." Therefore, these three are equal, and the measure of one is the measure of all according to this; but does it agree with the foregone definitions and formula? Does $E = Q = W$? "Your committee" says "Yes" here, but in all other places "No."

And these relations have been fully explained by Professor Thomson they say. If he has explained them, it is a pity they did not quote him: it would have enhanced the value of their report somewhat.

The fourth definition is electric resistance:—

"*Meaning of the words 'Electric Resistance.'*—It is found by experiment, that even when the electro-motive force between two points remains constant, so that the work done by the transfer of a given quantity of electricity remains constant, nevertheless, by modifying the material and form of the conductor, this transfer may be made to take place in very different times; or, in other words, currents of very different magnitudes are produced, and very different amounts of work are done, in the unit of time. The quality of the conductor in virtue of which it prevents the performance of more than a certain amount of work in a given time by a given electro-motive force is called its electrical resistance. The resistance of a conductor is therefore inversely proportional to the work done in it when a given electro-motive force is maintained between its two ends."

This last definition is of a piece with the other three. After attentively reading it over a few times, one finds that it says in effect that electric resistance is that property in a conductor which causes electricity to experience resistance in passing through it; but as to what resistance may be there is no hint. Whether it be of the nature of simple friction, or of the nature of the resistance experienced by a projectile which is made up of friction and gravity, or whether it be of some other nature altogether different from these, "your committee" sayeth not.

These definitions, if one may be permitted such a stretch of language as to call them definitions, we find in the third part of this report; but they ought to have been in the first. The first thing every one does, or ought to do, who treats on a scientific subject, is to define his terms. But "your committee" first give us a lot of formula, and then attempt to define the terms they have already formulated.

They tell us that these are laws of electricity, which they have formulated. Now, I would like to know how they know that these are the laws of electricity, since it is quite clear that they have no distinct idea of what they mean by the terms they use. Read these definitions of theirs, or, as they call them, meanings of words, and see if you have any distinct idea of what they mean.

A definition ought to be short, clear, and precise. But these—why they fill a page, and that with irrelevant and often contradictory statements about something which is evidently not settled in the writer's own mind.

One would suppose that if you want to determine a standard of measure of somewhat, it would be necessary at least to have some theory about what that thing is, and how it is related to other things.

But, sir, "your sub-committee" despises theory; one of them has said as much. They are all practical men, and certainly have proved it in this report; but it is by a practical muddle. In some parts of it electricity is a fluid, then it is a force, and then again nothing at all but a kind of state in which different kinds of matter may be. Again, it is two fluids, a positive fluid and a negative fluid; and the sum of these two fluids when added together is zero, or nothing; then immediately it is a negative force and a positive force. Now, what idea is it possible to form of a negative fluid or of a negative force? If it mean no fluid or force, why, let it be so; but why make any talk at all about nothing. Talk seriously about charging a bottle with a negative quantity of wine—would any one but a lunatic? But we are seriously told in this report, that a conductor can be charged with a negative quantity of electricity.—O, but electricity is very different to wine. True, but there can be no such thing as a negative quantity of anything,—a negation is a nonentity, but a quantity is an entity. How can two opposites exist together? Certainly "your committee" did not invent these absurd terms; but they talk gravely about them, as if they understood them.

If you will have it that electricity is a fluid, then speak of it as such; if a force, let it be a force: but in the name of common sense do not talk of negative quantities of either.

We are told at the beginning that the electrical phenomena

susceptible of measurement are four in number—namely, current, force, resistance and quantity; and we are referred to this third part for the definitions of these terms. It is quite clear that the current or motion must depend upon force and counter-force, or resistance; but it is only in one sense that quantity depends upon current and time. If it be meant that there will be twice as much force exerted when a current flows two minutes as there will be if the same current flows only one minute, it may be true in that sense; but this is not the sense in which quantity has been generally used. De la Rive gives tables where the quantity and intensity of different voltaic combinations are compared. He states that a Smee's element and a Grove's element of equal size give equal quantities through small resistances; but that the Grove's will give more than three times as much through a great resistance, and this property he calls intensity or electro-motive force. Now, we all know that this is so, or at least very near the exact relations of these two elements. But time does not enter into these relations. It is merely this, that an equal effect is produced by each after overcoming a small resistance, but that the effect produced after overcoming a great resistance is three to one. Is this a delusion? "Your committee" ignores this property of a current altogether, and gives one which is not an essential property at all; it is merely a statement that two is double the number that one is. Time may be a simple term included in the complex term current, but time cannot enter into these simples here named quantity and intensity. A current must include time, for a current is a motion through space. Moreover, there can be no motion without a sufficient force to maintain it; and this motion must produce a greater or less effect on matter in its vicinity. Also the effect produced must have some relation to area as well as length: and these four properties are absolutely essential to a current. Besides this there is resistance, which relates to the conductor or medium for the current. Now as time does not enter into resistance it may be ignored in current, and it cannot enter into quantity and intensity as here set down, for they are simple qualities of a current. If this property which is here spoken of as quantity—and not only here, but by most people—is not the real quantity, then what is it? It cannot be ignored without an error in your results, for it is an essential of the phenomena. But "your committee" have ignored it, and have said that universally quantity is current multiplied by time. It may be that they will tell us that this is for static electricity, as if one law did not govern all electrical phenomena, no matter how excited. Whenever the true law is found, it will be universally applicable. But how are they to find a true law? At least, this report shows that the authors of it lacked the power to separate the like from the unlike. They have mixed up in it electric and magnetic phenomena, and spoken of them as simply electric. It is true, that electricity and magnetism are inseparably connected, the one can never appear without the other; but to thoroughly comprehend them they must be mentally separated and considered apart.

One word more as to quantity and intensity as shown by a Smee's and Grove's element.

The two produce equal results through a small resistance; and it has been therefore said that these two sources produce equal quantities.

But if the currents from these two sources be caused first to traverse equal conductors of considerable resistance, then the current from the Grove's element produces three times the result that the current from the Smee's does, and this property in the Grove's element has been called intensity; therefore it has been said of a Smee's element, when compared with a Grove's, that it gives a current of equal quantity, but of one-third the intensity, or thereabouts. This is what we are given to understand by most authors, and I venture to think that it is what most practitioners have observed. But certainly "your committee" have not represented it in their definitions or formula. The first formula put down is Ohm's.

$$C = \frac{E}{R},$$

that is, current equals electro-motive force divided by resistance. If electro-motive force be quantity multiplied by intensity, as it looks to be when comparing Grove's and Smee's, we shall have, if we represent quantity and intensity by their ratios—for Grove's, $Q = 1$ and $I = 3$ when $R = 3$; and for Smee's, $Q = 1$ and $I = 1$.

Grove's $$C = \frac{E}{R} = \frac{Q.I}{R} = \frac{1.3}{3} = 1$$

Smee's $$C = \frac{E}{R} = \frac{Q.I}{R} = \frac{1.1}{3} = \frac{1}{3}$$

Now, if $R = 0$, or very small as compared with 3, this formula is not true; for C would then $= 3$ for Grove's, and 1 for Smee's; but in this case they are equal, as proved with Hearder's magnetometer.

My learned friends, do not lift your hands; I am not going to deny Ohm's law, as it is called, just now. I merely point out a difficulty which deserves your special attention.

The second formula is $Q = Ct$. In this formula Q represents the duration of a current only as measured by its flow, and is quantity in one sense certainly; but is not universally true for currents flowing from all sources of electricity.

The same may be said of the third formula.

The fourth formula is $$F = \frac{Q}{d^2}$$

If two insulated conductors be connected with the same pole of a battery, there will be a force exerted between them; and that force, F, is equal to the quantity, Q, flowing into them, divided by the square of the distance, *d*, between them.

To measure this force, a Peltier's electrometer, or some similar instrument, is used, and it is called the *tension* of the battery, or source; but "your committee" eschew that word *tension*—it is not exact, and *they* are so very accurate!

It is said in this report that the force is directly proportionate to the quantity, but it is not, even according to "your committee's" meaning of quantity; it has nothing to do with time, neither has it anything to do with current, for the conditions are that there is no current; therefore, according to them, if $Q = Ct$, it is simply false. But this force is proportionate to that which, with due deference, I think is aptly expressed by the "inexact word" tension—not intensity, that implies a current; but tension, a straining to produce a current. It is not due to quantity, as shown by a Smee's and a Grove's battery; but by that quality which is called intensity in a current, and tension when the current is restrained from flowing. These four are the whole of the purely electric formula,—the others by-and-bye.

INDOCTUS.

THE PATENT LAWS.—It is understood that the following will be the most important recommendations to be made by the Royal Commission which has been appointed to examine and report upon the Patent Laws:—"1st. That the present system of obtaining and paying for letters patent ought to be maintained; but that patent fees should not be made to contribute to the general expenditure of the State until every reasonable requirement of the Patent Office has been satisfied. 2nd. That no patent be granted if it be found, after examination, that there has been any previous documental publication of the invention; but that no investigation be entered into concerning its merits. 3rd. That one of the judges should sit for the trial of patent cases exclusively; that he should be assisted by scientific assessors; should sit without a jury, unless the parties to the suit or action desire a jury; and when sitting without a jury, that he should decide questions of fact as well as law. 4th. That the granting of licences to use patented inventions ought not to be made compulsory. 5th. That patents ought not to be granted to importers of foreign inventions. 6th. That no patent should be extended beyond the original term of fourteen years. 7th. That the Crown should be empowered to use patented inventions without having obtained the consent of the patentee, and should pay him for such use a sum to be fixed by the Treasury."

THE ATLANTIC TELEGRAPH ENTERPRIZE.

By Amicus.

From Ireland to Newfoundland, of course. Never heard of any other Atlantic telegraph. True, there is the Larmatian scheme—a route barbarous as the country it originates in; but this goes overland mainly; and such a land! Heaven preserve our noses from coming within fifty leagues of it. But, although this knouty line is to connect Europe with America by thin respective back-doors or sink-holes, it is not an Atlantic telegraph, and so don't see why we need say any more about it; those persons who wish to be informed thereupon may consult the pages of this journal with advantage. We feel very much disposed to pass it over, but it would be disingenuous to do so; and really we can afford to be generous; besides, envy, and disingenuousness, and ungenerousness, and such-like unbecoming qualities, we impugn henceforth. Truly we are large-hearted, and at this present feel such an unbounded gush of fraternity take possession of us that we can embrace the whole world with all its rival schemes. Doubtless, some of our friends over the left will say, "It's all very well for you to make a profession of magnanimity, and swell your capacious bosoms with benevolence; but we don't believe it, and it's all because you are first in the field, and your cable is being made, &c. &c.; but there's a lot of your people who are in pain at the midriff yet, and with but a faint prospect of recovery; and you yourselves would be preciously down in the mouth and misanthropic if it were not that you think and believe your business was looking up." Pooh, man! we can afford to extend the hand of fellowship even to you, and feel a pleasure in doing so. A truce to your quibbles. It is a proof of disinterested generosity that we herewith make known that we have heard that there is another project which assumes to be an Atlantic telegraph enterprize when hatched; at present, however, it is in embryo only. This is the Borean route, and takes us through a region where Sol plays strange vagaries, grossly inconsistent with his dignity as father of a large family. The wonder is how the respectability of the establishment is kept up. Pardon the digression. If you want to know anything more about this slumbering enterprize, apply at Rue de la Luna Bisected; in the meantime we wish it success "in Greenland's icy mountains," and elsewhere. And now with respect to our more immediate object. But stay; this paper should have been numbered—No. 2—certainly, it must be, as it follows the first. Never mind; don't trouble the compositor, or his demon, or any one else now; it will be understood that this is No. 2, doubtless.

In No. 1 we said either that the cable now being made differed very materially from that of 1857-8, or that the old one differed from the new: it does not matter which; it is a mile of one, and eight furlongs of the other. Yes, it differs in size, weight, application of materials, specific gravity, external protection, and all the rest—almost. Here are heads for our discourse; let us, therefore, take a plunge. In our long clothes we adopted a No. 16 copper as our conductor—an apt type of our own puling, unfledged condition. This was like constructing the sewers of London with tobacco-pipes, or supplying the main through a goose-quill. But we are wiser now, mind you; and although we do not rigidly adhere to our friend Thomson's excellent formula $\left(200 \epsilon \left(\frac{D}{D'}\right)^2 \text{loq.} \frac{D'}{D} \right)$, we nevertheless have fixed upon a conductor much more likely to do the business than the attenuated specimen above referred to; not a solid wire—oh no, but a strand of seven wires, in which six are laid spirally round a centre one; that, however, seems unnecessary information, just as if you could twist a seven strand upon any other principle. Each of these wires has a diameter ·048 of an inch, or, as some say, ·043; perhaps it does not matter which; different peoples' diameters seem to vary as much as their gauges: it is, doubtless, what our Brummagem friends would call a No. 18. Well, and what is the advantage of having seven thin wires twisted together instead of having one solid one, or a sectional tubular one like the Persian Gulf, with the same cubical contents of metal? Much, verdant friends; the conductor of the Persian Gulf cable is a very fanciful article, and although youth is prone to be fascinated by novelties, we have wisely resolved to look shy on this importation. Advantages, quotha! why they are obvious enough. If the conductor of a single wire cable break, there is a "breach of continuity," and breaches as a rule are very bad things. And it may be submitted that a case of "breach of continuity" would be as bad as a breach of promise, a breach-loader pointed at you from one hundred paces, a breach of faith, a breach in the defences of Richmond, and a multitude of other breaches. Now, the chances are that a strand of seven wires, bend and twist it as you may, will not all break together; one may give way, but continuity is preserved; but why try to enforce that which is self-evident. You have all heard of the wise old gentleman's last will and testament, and that it consisted in this:—"My sons, see if you can break those sticks one by one." "Oh dear, yes, nothing easier." "John, my eldest born, band the fagots together; now try. Aha! you cannot;—good. Apply the moral, my children, and prosper. You are all my executors, Benedicite!" It would be insulting your well-known penetration to dwell further upon the advantages of a strand wire over a solid one; but it will have forced itself upon your perception that this has greatly the advantage over the old conductor by virtue of its being about three times the weight; this weighs some 300 lbs. per nautical mile against 107 of the old one. We are conscious of some mistake here, for which, however, we are clearly not responsible. The weight of the old conductor, if it were in No. 16 wire, would not have exceeded 75 lbs. per nautical mile, and so, at that rate, the new one will be four times the weight. "And a pretty telegraphist you must be," says some one, "not to know whether it were a No. 16 copper or no." But our extreme puerility at that time will surely extenuate what would otherwise be inexcusable haziness. Alas, friends, we were too juvenile and too much intoxicated with our brief but unparalleled success. Now, this increase of weight, like increases in bulk in general, has reference to increased capacity for doing an increase of work; this principle is really so universal as to require very little illustration. Doubtless, you remember how many tailors it takes to make a man; and that is the aptest illustration it is possible to furnish. The conductivity of a thin conductor is so nullified by induction as to render its being worked through with any comfort, for two thousand miles, extremely problematical; seeing that conductivity is as its sectional area, while inductivity is as its circumference only, it follows therefore that, although you increase its inductivity by enlarging the circumference of your conductor, you at the same time increase its conductivity at least fourfold. What is the conductivity, or more properly speaking, the measure of locomotion of a little thin wisp of a man in a dense crowd—say in Fleet-street on last illumination night? Literally nil; and yet the inductive process was awfully exhaustive. But place a six-foot bush-ranger or Leicestershire farmer, with dimensions in proportion, in the same situation. Heavens, what a seething state he would be in! His inductivity (perspiration) would be far greater than the others; but his conductivity (propulsion) would be thorough and effective, for he would pull through in time.

Tut! it is absurd to suppose we wish to practise on your credulity. We signalled at the rate of 2½ words per minute through the old cable; that you may believe or not, as you please; it is on record, and is therefore indubitably true. It follows therefore that the superior quality of the copper (its conductivity is 85° from 100° of pure copper, while the old conductor was probably on an average not more than 60°), and its quadrupled bulk, will enable us to signal at double that speed; at least, supposing no better instruments are used than were in vogue in '58. According to our talented and esteemed friend Varley's table, however, we shall speak through it at the rate of eight words per minute, and this is probably nearer the mark; indeed, it may be safely calculated upon. Then let us do a sum in arithmetic: $8 \times 60 = 480$ words per hour, and $480 \times 24 = 11{,}520$ words per day; how many for one week, a month, a year, or any other division of time, you must please work out for yourselves. Of course we shall work day and night, and make seven days every week. Our clerks and employés will have holidays, go to bed and church for all that, as we shall work upon the relay system, in more senses than one. It is in the nature of youth to be sanguine; our eating the cake, therefore, before it is baked will be excused; for the sake of brevity, however, it is a fault we should eschew.

The A1-ness of the conductor may, we think, be admitted; proceed we, then, to its dielectric. Process 1. The interior wire of the strand is handsomely coated with "Chatterton's compound;" the consequence is that when the strand is thrown up, this viscid substance is squeezed very nicely into the interstices of the strand, and thereby prevents any open space whereby water could trickle through between the conductor and insulator; now, if that is not a clever contrivance, we should be glad to be informed what is. Well, having perfected the rotundity of the conductor, excluded all the air from the crevices, secured mechanical solidity to the entire core, and at the same time lessened its inductive action,

Process No. 2 follows: that is, a coating of Chatterton's compound round the whole conductor. Then Process 3—a coating of gutta-percha—and so on alternately in a series of processes, which need not be numbered any further, until the desired thickness of insulation is attained. "But why this alternation of Chatterton's compound with gutta-percha?" asks some novice. Why, man, to make the insulation more perfect, to be sure. Suppose, when the first coating of gutta-percha is applied, there should be any small pores or what not left in it,—remedy: apply a thin coating of Chatterton's compound, and forthwith the inimitable preparation works into these minute gaps or orifices, and makes the whole as neat, and as nice, and as perfect as possible. Talk about Hughes's fluid; very good stuff, doubtless, but where's the use of it when we have a compound, the patent and working of which is held by our magnanimous friends, the Gutta-percha and Telegraph Works Company (Limited), which answers infinitely better? These admirable substances are hand and glove, and work first-rate together. Chatterton's compound is a sincere friend, who hides the defects of his ally. And gutta-percha has an affection of surpassing excellence, that casts a mantle of oblivion over a brother's nakedness. Croakers will come in here as usual, and ask, "Why use two materials when another might have been adopted which would have done the work far more effectually than the two combined?" Heigho! you are waiting for answer very likely; sorry you cannot be accommodated; the fact is, our space is exhausted, and our patience likewise. We will take your suggestions into consideration, however; think there is something in them; in the meantime, wish you success; shall have no objection to make experiments on a trial cable at your expense, and for the present beg you will accept our most distinguished consideration.

The total weight of insulation will be 400 lbs. per nautical mile, the thickness of dielectric about ·174 inch, and the total diameter of core nearly half an inch; a very nice size, indeed, neither too large nor too small, but just right, like the multifarious appurtenances of the "little, small, wee bear." True, it is not in strict conformity with Professor Thomson's formula as before observed; but bearing in mind that there is a limit to the size and weight of this cable, which circumstances necessarily enforce, it may be unhesitatingly asserted that these proportions of conductor and insulator present the most favourable that are to be found in our worthy electrician's table, which you are further entreated to remember was endorsed by the eminent mathematician above named. There is a further proof of superiority in this cable—its insulation alone being considerably heavier than the whole core of its predecessor. And when we add, what in bare justice we are bound to assert, that our friends at the Works are bestowing an amount of care, attention, and vigilance on its manufacture, &c., hitherto unprecedented, we may surely indulge in the most sanguine prospects of success. But we have not done with the core yet, although we have with its objectors for the present. Certainly not; it is tested ever and anon, or electrically examined as it comes from the manufactory, and if the lengths pass muster, they are then submerged for a day and a night in water at a temperature of 75° Fahrenheit. Not very hot certainly, but considerably more tepid than the piscatory denizens of the Atlantic would care about, and hence we may safely assume that old Neptune will not subject it to a similar ordeal when he comes into possession. This is a remarkable instance of our singular disinterestedness. We wish the cable to be tested under the most unfavourable circumstances, and so parboil it, for you all know that the insulating capacity of gutta-percha is decreased by heat; so is the discretion of man when heated by argument, his self-control when heated by passion, his wit and wisdom when heated by love, and his power of speech and locomotion when heated by wine. Besides, this parboiling process secures uniformity of condition when under test; and seeing that these tests are made at a temperature of 20° higher than the Atlantic, it allows a safe margin against disappointment at the effects of temperature after submersion, should it so turn out that the hoary god has a boiler in his kitchen, and we should be so unfortunate as to stumble on it in our route. Well, when the core has undergone this soaking, it is expected, and, indeed, does show an insulation amounting to a large but various number of millions of units, which variation depends upon whether you take "Varley's," or "Mercury," or British Association units—we refrain from the enumeration, it is an exhaustive process—this is a severe test, gentlemen, but it stands it nevertheless, and affords proof positive that the thing is being done as it should be; indeed, we don't mind stating confidentially that the least perfect part of the cable shows an insulation of double the high standard required. And then it is tested on other and various instruments of the most delicate and searching description, compared with which the discovery of a grain of gold in the Caucasus is a mere bagatelle. And then the officers of the Atlantic Company take it in hand, so that altogether it is just impossible for a defect to go undiscovered. Then, after having been wound on reels for the purpose of being subjected to the hydraulic pressure test for insulation, it is then rewound on large drums, and carefully examined inch by inch; surely a work of supererogation, we would think; but then we like to be particular, and mean to go on a safe card. And it is seriously entertained, moreover, that an apparatus be constructed which shall enable the whole cable to be examined from end to end after submersion, and that splicing and other repairs shall be conducted sub-aquæ; this by the way, however. Due notice will be given of these novelties by-and-bye. We will get the cable made and laid first; in the meantime, *sub judico lis est.*

Having been wound on these drums, the core is sent to East Greenwich to be sheathed, after which it is again subjected to the complete series of tests above described. Of course these drums, or rather their contents, are carefully secured against injury in transmission, and on their arrival at the above place, are forthwith placed in tanks filled with water, and locked up securely, as all precious and expensive commodities should be. And having got our cable thus far, perhaps we cannot do better than leave it there for the present, lest your patience be exhausted as well as ours, and there be nothing left for us to say on a future occasion. Youth will be soaring as well as sanguine, and so we shout, "Excelsior!" and bid you all join in the chorus. We will meet you again. For the present, *valete ac plaudite*, if it be not immodest.

CORRESPONDENCE.

MR. THOMPSON'S INDUCTION MACHINE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I quite agree with your Parisian correspondent that quantity, as well as tension, is required in a current of electricity to produce the electric light; but not at all when he states:—"The only light to be obtained from the induction machine is that produced in the vacuum." If he had said from induction machines similar to Rhumkorf's, it might have been true. I would ask him to suspend his judgment till he has seen mine. I have not yet had two opinions expressed upon it by those who *have* seen it.

Your correspondent speaks very positively about what an induction machine can and cannot do, as if the thing was settled and known to the very bottom. For my own part, I do not find that any one who has written on induction puts down his notions so very clearly that you can have no doubt that he understands precisely how the thing takes place; nay, I will say farther—I have not met with one who gives an understandable description of how it takes place, neither oral nor written.

I should be glad to have your correspondent's ideas on this matter. Not simply an induction machine does this, and it does not do that; but the how and the why. J. BAYNES THOMPSON.

22nd November, 1864.

THE EXPLOSION AT THE OFFICES OF THE UNITED KINGDOM TELEGRAPH COMPANY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—In the notice of the gas explosion at the United Kingdom Telegraph Company's office, Liverpool, which appeared in your valuable journal of the 12th instant, the following paragraph occurs:—"The gas had made its way through the crevices in the flooring, *and being heavier than the air*, had hung about the ground till its whereabouts was so startlingly announced upon the application of a light." Now, it appears to us that this gas is of a most mischievous character, and requires looking after. In the first place it obeys, in a very docile manner, a law of nature consistent with its specific gravity, and comes up through the crevices in the floor; but having arrived at this stage of its ramble, it suddenly turns refractory, and skulks about the floor until approached by a light, at which it immediately makes a plunge, and the result of the conflict is eternal squash to all the windows in the office.

We have been speaking to a friend of our's about the matter, and after grave deliberation he gives as his opinion that it must have been the same sort of gas that Mr. Coxwell filled his balloon with at Leicester, and which caused that unfortunate apparatus to linger "about the ground," until it got chastised with such tremendous effect by the local members of a society of gentlemen called Foresters. Of course, in mentioning this, you must understand we do not mean to imply that we entirely endorse our friend's opinion.

Our old schoolmasters used to tell us all about hydrogen and its chum, carbon: that the former was fourteen times lighter than common air, and all that sort of stuff; but of course, living as we do in the midst of such prodigious triumphs of the human mind, we naturally feel desirous to keep

as close to the heels of modern discovery as possible. We therefore beg you will request your Liverpool correspondent to favour us with a little more information about this peculiar gas, which information, we are sure, will be hailed with great delight by your numerous admiring readers, among whom will be found your devoted servants,

London, 23rd November, 1864. JOHN AND WILLIAM THOMAS.

THE ATLANTIC TELEGRAPH ENTERPRIZE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—There is an article in your journal of this week on the "Atlantic Telegraph Enterprize" by a would-be funny man, who signs himself "Amicus." It is clear that he is trying to imitate the style of some one, the spasmodic effort is so evident. I have seen writing before under the same signature, and evidently from the same pen, from many expressions common to both. I find it was on the Bath Meeting of the British Association that "Amicus" wrote before. He was not then offensive as now—nay, he even sometimes approached within sight of common-sense; but now when he wants to make believe that he is witty, he is worse than unbearable. I can only account for your putting his article in print, that you wished to hold up the mirror of his own vulgarity to him, that he might be thoroughly disgusted with himself, and eschew in future even the thought of a similar offence against decency. He appears to have mistaken slang for humour, and lower slang I should think was never before written. As to his meaning, if he has any, one cannot tell what it is. Who can bear to rake into such a heap of rubbish? It would be like groping in sewage for a farthing. BIRCH.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—There is but one step from the sublime to the ridiculous, and if ever your contributor "Amicus" found himself in the former condition, it is evident he beat a hasty retreat to a more congenial state—the state in which we behold him. In your last number "Amicus" affects to discourse on the Atlantic telegraph enterprize, but after writing the headline his spirit appears to have failed him, and he proceeds to indulge a morbid appetite for American inelegancies, to show his appreciation of the usefulness of Mr. Hotton's Slang Dictionary, and to evince his acquaintance with the national lyrics of the two countries which are about to be united by a telegraph cable across the bed of the Atlantic. Your contributor is without doubt "a verra clever person," but he lacks the good taste and common-sense so necessary to a writer who aims to address a class of enlightened readers on a subject of importance. There may have been a deal of jobbery in the arrangements which were effected a few months since between two large firms now engaged in the manufacture of the Atlantic cable; the scientific committee who reported in favour of the cable submitted by Messrs. Glass, Elliot & Co. may have been a "heterogeneous conglomerate of discordant elements;" and one member of said committee may have disavowed "all personal responsibility as to having advised this or that;" and no blame to your contributor for speaking of these things. Orderly criticism is often beneficial, but really the manner in which "Amicus" has ill treated "The Atlantic Telegraph Enterprize" is deserving of censure. He has not uttered a syllable worth a thought as to the project *per se*, but by silly exclamations, offensive interjections, and vulgar comparisons, he has sought to heap contempt upon the officials of the Atlantic Telegraph Company. If "Amicus" entertains the conviction that he can approach the understandings of those to whom he addresses himself more particularly by nonsensical palaver and puerile banter, he errs grievously. It can hardly be supposed that persons whose privilege it may be to be able correct abuses will pay any heed to a paper, be it headed with ever so startling a title, when they find at the outset a trifling with words and a pandering to low instincts unworthy a clown at one of the Surrey-side theatres. If, as your contributor suggests, the scientific committee have wittingly or unwittingly betrayed their trust, let him point out their errors, in order that they may be rectified before it be too late, not in the language of the buffoon, but in terms which will command the serious consideration of your readers. Yours truly,

Isle of Wight, 24th Nov., 1864. WALTER ELMSDALE.

SOUND AS A TIME MEASURE.—In a recent French work entitled *Traite des Mecanismes*, by M. Haton de la Goupilliere, we find described a curious and ingenious method of measuring time, which gives thousandth parts of a second. The description is substantially as follows:—Suppose it were required to measure the exact time of the descent of the hammer of a gun-lock on the nipple. The motion is so rapid that the most delicate stop-watch is at fault. A needle might be fixed to the hammer, so as in descending to mark a curve on a blackened metal plate; but still the time would be an unknown quantity. It may, however, be measured by means of a tuning-fork, also provided with a marking needle; then while the former one marks the curve described by the hammer, the second needle will mark the vibrations of the fork; and as we know that they are isochronous, each of the small insinuosities thus obtained on the blackened plate will represent a fraction of time, and show how many such fractions elapsed before the fall of the hammer. To give an idea of the degree of precision which may be obtained by this process, let us suppose the normal French tuning-fork, which will perform 896 vibrations in a second; then the duration will be 1.896th of a second; and as the greatest error that can be committed cannot exceed half a vibration, the measurement will be exact to 1.1792d of a second.

TELEGRAPHIC NEWS.

TELEGRAPHY IN VICTORIA.—Melbourne has been connected by electric telegraph with Sale, Gipp's Land.

THE LATE GALES.—Telegraphic communication in the Southern part of Italy was interrupted on Monday the 7th instant in consequence of the prevalence of stormy weather; but it was perfectly re-established on the evening of the following day.

LOSS OF A TELEGRAPH CABLE.—The cable of the Victoria extension of the Oregon and Washington Territory line of telegraph, which was intended to lay across the Straits of San Juan de Fuca, was lost with the British ship Thebes, off Cape Horn, on the voyage from London some weeks ago.

AUSTRIAN TELEGRAPHS.—From the papers recently submitted by M. Von Pleuer, Minister of Finance to the House of the Reichsrath, we gather that in the year 1862 the revenue derived by the Government from the postal and telegraphic services amounted to 16,605,673 florins.

NEW ZEALAND TELEGRAPHS.—Arrangements are now so far advanced for telegraphic communication between all the provinces of the island of Nelson, that we may calculate on seeing the electric wire in full operation during the ensuing summer. The last contract for the supply of poles has been taken. The wire and other apparati was long since ordered from England, and such portions as have not yet been landed will reach their destination very shortly.

STANDARDS OF ELECTRICAL RESISTANCE.—The following resolution was passed at the last meeting of the British Association on this subject:—"That the Committee on Electrical Standards, consisting of Professor Williamson, Professor Wheatstone, Professor W. Thomson, Professor Miller, Dr. A. Matthiessen, Mr. Fleeming Jenkin, Sir Charles Bright, Professor Maxwell, Mr. C. W. Siemens, Mr. Balfour Stewart, Dr. Joule, and Mr. C. F. Varley, be re-appointed; that Mr. Fleeming Jenkin be the Secretary, and that the sum of £100 be placed at their disposal for the purpose."

THE TELEGRAPH IN MEXICO.—Advices from America in the New York papers mention that telegraphic lines are to be established between the leading cities of Mexico, communicating by way of Texas with the United States; that another line is to connect Mexico with Yucatan; and that a submarine cable will be laid to Cuba. "In this way," it is remarked, "the city of Mexico is expected soon to be in direct and instantaneous communication with New York, Havannah, and San Francisco." As Texas, however, and the other intervening States up to the frontier of Maryland, are under the Confederate Government, it is evident that telegraphic intercourse with New York cannot be effected by that route until the conclusion of the war.

THE TELEGRAPH IN RUSSIA.—The Director of Telegraphs in Russia has received information that the wires have suffered severely from a fall of rain mixed with hail, while the thermometer marked three degrees below freezing point. The rain which fell on the wires was converted into icicles strong enough to break them. A violent wind came on, which threw down a number of the posts supporting the wires. The consequence is that the service is completely interrupted between Kharkor, Krementschug, and Bakhmut, also on the line between Krementschug and Kiev, and the line connecting Jitomir with Odessa, and the Crimea.

TELEGRAPH FROM LONDON TO CHINA.—The Russian Government have completed the public line of telegraph throughout European Russia and Siberia in Asiatic Russia to Kiakhta, the frontier town of China. Kiakhta lies to the north-west of Pekin, and is distant about 750 miles from that city. It is therefore possible to send a communication from London to the capital of China in about four days. The line from St. Petersburg to Kiakhta extends over a distance of some seven or eight thousand miles, and its completion so far is an event of great importance, not only to European merchants, but also to the different Governments whose Ministers reside in the Celestial City.

THE ATLANTIC TELEGRAPH.—There are seven copper wires to form the conductor. The entire length of the cable will be 2,300 miles, so that there is 16,000 miles of copper wire. Every portion of this copper wire is subjected to electrical tests to ascertain its conductive capacity before it is allowed to be worked up. The next step is to coat these wires with eight successive layers of the insulating material, viz:—Chatterton's compound and gutta-percha, equal to an aggregate length of 18,400 miles. This core is next covered with jute wound round it from ten strands, making 23,000 miles of jute yarn. Then comes the outer protection of the cable, formed of ten covered iron wires. The iron wires itself is 23,000 miles in length, and each wire is covered separately with five strands of tarred hemp, 135,000 miles of the latter being required, making together an aggregate length of material employed of 215,500 miles, or very nearly as much as would put ten girdles round the earth, or form a line that would almost reach from the earth to the moon.

THE SUBMARINE CABLE BETWEEN TASMANIA AND VICTORIA.—The select committee appointed by the House of Assembly to inquire whether any, and if so what, means could best be taken for the restoration of the submarine cable now lying between Tasmania and Victoria has brought up its report, in which it is stated that it would be undesirable, in a pecuniary point of view, to take any steps for the re-establishment of the present cable. The only witness examined by the committee was Mr. W. R. Falconer, the director of public works, who gave a history of the cable since its submergence. His evidence went to show that no one portion of the cable is at present in working order. The cable might be repaired but at any

considerable expense: it would be impossible to estimate the cost without a survey. He believes that great advantage would accrue to Tasmania from the renewal of telegraphic communication with Victoria, but it would not be commensurate with the outlay necessary for repairing the old cable. To lift the cable, for the purpose of selling it, would cost more than any sum it could afterwards realize. He cannot even recommend that a portion of it should be raised, if required, for laying across the river Derwent, as this might involve a greater expenditure than the cost of a new line of cable. During his examination Mr. Falconer handed in the report of Mr. M'Gowan, superintendent of telegraphs in Victoria, in reference to the leasing of the line, and repairs, the annual receipts and expenses of the line. This report was given to Captain Gilmore, when preparing to visit England, about two years ago, with a request that he would endeavour to make arrangements in England with parties to repair the line, and afterwards lease and work it. Captain Gilmore on his return from England stated verbally to Messrs. M'Gowan and Falconer that no parties he had seen in England on the subject would entertain the proposition; and he also stated that he had been informed that "it was one of the worst cables ever manufactured in England, and that it had not been made to last."

MISCELLANEA.

Royal Institution Lectures.—Professor Tyndall, F.R.S., is announced to deliver a course of twelve lectures on electricity on Tuesdays and Thursdays, commencing on the 17th January, and concluding on the 23rd February, 1865. Each lecture to begin at three o'clock.

A Definition.—An engineer has been defined by a contemporary to be a man more or less gifted with the constructive faculties, furnished with a sound education in the modern sciences, and one who has passed as much time in the work-shop as in the lecture-room.

New Quicksilver Mine.—The discovery of a quicksilver mine has just been made at New Rhonard, near Olpe, Westphalia, the yield of which promises to be large. The exploration is being vigorously pushed. During the past few weeks more than 4,000 lbs. of quicksilver have been extracted.

The Great Exhibition Building.—On Saturday, the 19th instant, the Sappers and Miners, under General Sir J. Burgoyne, Colonels Lovell and Scott, and Lieut. Knocker, continued their operations in connection with the removal of the remaining portions of the Great Exhibition building. The portion of the building to be displaced was the great octagonal tower in the Cromwell-road. The chambers were charged with about 50 lbs. of powder, in addition to a considerable quantity of gun-cotton, and at twelve o'clock the batteries were simultaneously fired by electricity, the effect being the almost instantaneous fall of the tower. The experiment was one of the most successful that has yet taken place. Owing to the proximity of the houses in Cromwell-terrace, the windows of which were filled with spectators, the utmost care had to be taken. The next and final operations of the Engineers will be directed to the removal of the grand entrance, in the Cromwell-road, where the mass of material is very great.

Dangerous Chimneys.—It is a serious question whether, in the ornamentation of large chimney tops, we do not incur great responsibility. When it is thought advisable to terminate with a handsome cup, with great projections, cramps of some metal are necessary. Now as these cramps are great conductors of the electric fluid, they become extremely dangerous. According to Sir Snow Harris, and other electricians, the gases passing up the chimney are a great means of conducting lightning, but with the metal cramps added, the worst possible arrangement is completed. During the summer alone we have had many instances of chimneys and other buildings having been struck by lightning, and all the projecting stone-work sent off, in some cases to a considerable distance, to the great danger of all those whose duties required that they should be near such erections.

Bavarian Finances.—The financial period of the country is six years. The budget once voted cannot be changed till the whole period has expired. In 1856, the first year of the seventh period, the revenue of the kingdom amounted to 83,154,571f. from indirect, the rest being the produce of the domains and monopolies of the State. The expenditure for the same year was fixed at 86,933,410f., leaving a deficit of 3,778,839f. The interest of the national debt forms 31 per cent. of the whole expenditure, the army 22½ per cent., and public instruction 2 per cent. The budget voted for the eighth period, 1861-67, estimates the receipts at 96,113,265f., and the expenditure at 97,693,254f., with a yearly deficit of 420,000f., which is to be covered by the surplus receipts of the preceding year, if there be any. The most important item of the expenditure is the interest of the public debt, 28,468,490f. on a capital of 693,960,960f. The army costs 23,971,500f. a year, and public instruction 2,421,453f. The expenses of the judicial administration are about 7,350,000f. The direct taxes, comprising those on land, buildings, property, and income, are estimated at 19,599,378f. The indirect taxes, consisting of the excise and customs duties, stamps, registration dues, and sundries, produce 38,346,730f. The monopolies of the State, such as mines, railways, the navigation of the Danube, and the electric telegraph, bring about 21,000,000f. into the treasury, and the crown lands nearly as much. A sinking fund has been instituted for the extinction of the debt; it operates yearly, but to a very small extent. Besides, the length of the financial period is opposed to any considerable movements in the state of the budget.

Quick Travelling in 1620.—"*Barnard Calvert of Andover*, rode from St *George's* Church in Southwark to Dover, from thence passed by *Barge* to *Callis*, in *France;* and from thence returned back to St. *George's* Church, the same day. This, his journey, he performed betwixt the hours of three in the morning and eight in the afternoon."—*Medulla Historæ*, 1683.

Electric Polarity.—Some new facts relating to this subject have been noted by M. Volpicelli, and reported by him to the Academy of Sciences at Paris. He says:—"It is certain, if the metallic extremity of a copper wire covered with gutta-percha be placed isolated over a dry-pile condenser, that, by making it temporarily depart from the vertical position, it will manifest positive electricity; but, if it be previously agitated, it will manifest negative electricity. I have also proved that paraffin, touched very lightly with two fingers, gives positive electricity; but when touched less delicately it manifests negative electricity. These two facts confirm the existence of electrostatic polarity in the substances, produced by a more or less energetic touch. Paraffin, mixed with Steiner's amalgam, increases the electric tension of machines. In delicate electrostatic experiments, we must absolutely remove the shellac placed between the two plates of the condenser, and replace it by two parallel threads of white silk, more or less fine, according to the circumstances of the case."

Utility of the Electric Light.—The *Courrier de Bretagne* gives an interesting account of recent experiments with the electric light at Lorient, France. The night was dark, many spectators assembled, in addition to the engineers and officers comprising a commission appointed specially by the maritime prefect. First, the great dock, in which two ships were under repair, was rendered as light as day, so that the engineers were enabled to go down into it and examine all the details of the repairs. Next a signal mast was fixed, at 700 yards from the Duchayla, and at 500 from the Panama steam frigates; the signals given by flags from the summit of the mast were rendered perfectly visible on board the two ships by means of the electric light. A third experiment caused great surprise and admiration. A diver descended 20 feet under water, and by means of the light was enabled to distinguish the decimal divisions on a scale which was sent down to him and to give proofs of it. This experiment was deemed conclusive. It is now established that an electro-magnetic machine may be permanently fixed to light large workshops, submarine works, and narrow passages into harbours. It was further observed that when the light was brought to bear on the water shoals of fish were attracted by the unusual appearance, and continued to swim around the part lighted. Eels and other fish which were at the bottom of the sea, came up to the surface.

Professor Tyndall on Luminous and Obscure Radiation begins the *Philosophical Magazine* for November. After referring to the discoveries of Sir William Herschel, Sir John Herschel, and Melloni respecting the obscure rays of the red end of the spectrum, he says—"Dr. Akin inferred, from the paucity of luminous rays evident to the eye, and a like paucity of extra-violet rays, as proved by the experiments of Dr. Miller, that the radiation from a flame of hydrogen must be mainly extra-red; and he concluded from this that the glowing of platinum wire in a hydrogen flame, as also the brightness of the Drummond light in the oxyhydrogen flame, was produced by a change in the period of vibration." Dr. Tyndall adds, that by a different mode of reasoning he arrived at the same conclusion. The present paper contains a description of his numerous experiments demonstrating the character of the radiation from a hydrogen flame under a variety of conditions, the apparatus employed, and the results obtained. We select a few of the results. Fifty experiments on the radiant heat of a hydrogen flame make the transmission of its rays through a quantity of iodine, which is perfectly opaque to light, 100 per cent. To the radiation from a hydrogen flame the dissolved iodine is therefore perfectly transparent. It is also sensibly transparent to the radiation from solid bodies heated under incandescence, and to the obscure rays emitted by luminous bodies. Professor Tyndall found that, dividing the radiation from a platinum wire raised to a dazzling whiteness by an electric current into twenty-four equal parts, one of these parts is luminous and twenty-three obscure; dividing the radiation from the most brilliant portion of a flame of coal-gas into twenty-five equal parts, one of those parts is luminous and twenty-four obscure; dividing the radiation from the electric light emitted by carbon points and excited by a Grove's battery of forty cells into ten equal parts, one of these parts is luminous and nine obscure. We have only space for the following remarkable conclusions:—"On a tolerably clear night a candle flame can be readily seen at the distance of a mile. The intensity of the electric light used by me is 650 times that of a good composite candle, and as the non-luminous radiation from the coal points which reaches the retina is equal to twice the luminous, it follows that at a common distance of a foot the energy of the invisible rays of the electric light which reach the optic nerve, but are incompetent to provoke vision, is 1,300 times that of the light of a candle. But the intensity of the candle's light at the distance of a mile is less than a 20,000,000th of its intensity at the distance of a foot; hence the energy which renders the candle perfectly visible a mile off would have to be multiplied by $1,300 \times 20,000,000$, or by 26,000,000,000, to bring it up to the intensity of that powerless radiation which the eye receives from the electric light at a good distance. Nothing, I think, could more forcibly illustrate the special relationship which subsists between the optic nerve and the oscillating periods of luminous bodies. The nerve, like a musical string, responds to the periods with which it is in accordance, while it refuses to be excited by others of vastly greater energy which are not in unison with its own."

Some Meteoric Phenomena are described by M. Lespiault in a letter read at a recent meeting of the Academy of Sciences, at Paris. On the 24th of September last, about twenty minutes after mid-day, he was with his brother in the vine grounds near Nerac, when, the heavens being perfectly clear and the air calm, suddenly they heard a detonation resembling that produced by the explosion of a distant mine, which was followed by a prolonged rolling, like that of thunder or of an approaching vehicle. The sound filled the air surrounding them and did not seem to come from any particular direction. It continued for about thirty seconds, then became feeble, and then returned to its first intensity, the total duration being about a minute. The same noise was perceived in the neighbourhood at a distance between a mile and a mile and a-half.

Imports and Exports of Quicksilver.—In the first nine months of the present year not less than 3,714,174 lbs. of quicksilver were imported into the United Kingdom. This quantity is an increase on the amount received in the same period in 1863 of 2,561,441 lbs., and on that relating to 1862 of 3,282,036 lbs. Heretofore this commodity was imported principally from Spain; but of late considerable quantites have been brought from California. The exports of this article in the nine months ended 30th September last were 2,504,921 lbs., against 1,126,533 lbs. in the corresponding period of 1863, and against 719,028 lbs. in the same time of 1862. The bulk of the shipments is sent to Mexico, Peru, India, and Australia.

Minium of Iron.—The society called the Académie Nationale, of Paris, has awarded a medal to M. de Cartier, for his preparation of Minium de fer d'Anderghem—the name of the place of manufacture in Belgium. The Société d'Encouragement and the Société Centrale des Architectes, also of Paris, have likewise reported favourably on the product. The minium of iron is said to answer all the purposes of white lead, and other preparations of the like kind, to possess more solidity, to be cheaper, to last longer, and to have an especial value in preserving iron from oxidation, and rendering the surface of wood hard. Remarkable freedom from acid or adulteration is claimed for M. de Cartier's product, which is also said to lie on iron surfaces evenly and smoothly, like a varnish, effectually excluding air.

The Hydrostatic Electrometer.—We give a concise description of Sir Snow Harris's hydrostatic electrometer, as recently perfected and improved, which has been so essential to the successful prosecution of his researches. In this instrument the attractive force between a charged and neutral disc, in connection with the earth, is hydrostatically counterpoised by a small cylinder of wood, accurately weighted, and partially immersed in a vessel of water. The neutral disc and its hydrostatic counterpoise are freely suspended over the circumference of a light wheel of 2·4 inches in diameter, delicately mounted on friction wheels, so as to have perfectly free motion, and be susceptible of the slightest force added to either side of the balance. Due contrivances are provided for measuring the distance between the attracting discs. The balance-wheel carries a light index of straw reed, moveable over a graduated quadrantal arc, divided into 90° on each side of its centre. The neutral attracting plate of the electrometer is about 1½ inch in diameter, and is suspended from the balance-wheel by a gold thread over a similar disc fixed on an insulating rod of glass, placed in connection with any charged surface, the subject of the experiment. The least force between the two discs is immediately shown by the movement of the index over the graduated arc on either direction, and is eventually counterpoised by the elevation or depression in the water of the hydrostatic cylinder suspended from the opposite side of the wheel. The divisions on the graduated quadrant correspond to the addition of small weights to either side of the balance, which stand for or represent the amount of force between attracting plates at given measured distances with given measured quantities of electricity. This arrangement is susceptible of very great accuracy of measurement.

PATENTS.

APPLICATION FOR LETTERS PATENT.

2868. G. Score and R. W. Sievier, improvements in the means of communication for railway travellers with the guard.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2423. F. N. Gisborne, improvements in the means of working electric signals for gunnery practice.
2536. L. J. Crossley, improvements in supporting and insulating overground telegraph wires.
2681. L. P. G. Bellet and C. M. P. De Rouvre, certain improvements in the application of electricity as a motive power.
2687. J. H. Simpson, improvements in electric printing for telegraphic and other purposes, and in the apparatus to be used for such purposes.
2690. J. Solomon and A. G. Grant, improvements in lamps or apparatus for burning magnesium and other metallic substances.
2712. F. J. Scott, improvements in means or apparatus for signalling between passengers and guards, or others, on railway trains.

PATENTS SEALED.

1386. W. Clark, improvements in electro-magnetic and magneto-electric apparatus, and their application as a stationary or locomotive power.
254. A. Bertsch, improvements in lightning-conductors for preventing atmospheric electricity damaging electric instruments.

PATENTS WHICH HAVE BECOME VOID.

2800. W. A. Shepard, improvements in preparing and treating gutta-percha and india-rubber.
2817. J. Fisher, improvements in apparatus for indicating or regulating the passing of railway trains.
2836. J. Davidson, improvements in apparatus for communicating between the passengers and the guard and engine-driver of railway trains.
2841. J. T. Way, improvements in obtaining light by electricity.

NOTICES TO PROCEED.

1804. H. E. F. De Briou, an improved composition for protecting and preserving metals, such as iron, copper, or zinc, used in the construction of ships, or in the protection of their sides and bottoms from oxydation and corrosion from the action of sea-water, and for protecting from corrosion all submerged substances, such as chains, anchors, cables, and every oxydable metal submerged in water or exposed to atmospheric influences.
1823. A. V. Newton, improvements in electro-telegraphic apparatus.—A communication.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good	1/9 to 2/	per lb.

INDIA RUBBER.

Para, first quality	1/7 to 1/8	„
second „	1/4 to 1/5	„
third Negro-head	1/1 to 1/2	„
Java and Penang	1/2 to 1/4	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	105 to 108	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{3}{4}$ to $\frac{1}{4}$ dis.	—

TO CORRESPONDENTS.

Alfred Rowbottom.—The specific gravity of iron (pure) is 7·70; of aluminium 2·67.

Amateur.—Messrs. Singer & Co., of the Vauxhall Pottery, Vauxhall, manufacture a very useful porous cell.

J. Montgomery.—The most useful work for your purpose is Culley's "Handbook of Practical Telegraphy." London: Longman & Co., Paternoster-row. Price 7s. 6d.

E. Turner.—The phenomenon you describe is common to all sulphate batteries. Clean well with turpentine and grease the edges.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co. Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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TO ADVERTISERS.

Clerks, assistants, manipulators, and instrument makers, seeking employment &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electrical apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

Advertisements must be delivered to ensure insertion before Seven o'Clock on Thursday evening in each week. The charges for Advertisements are—

	£.	s.	d.		£.	s.	d.
Whole page	4	4	0	Quarter page	[illegible]	[illegible]	[illegible]
Half ditto	2	10	0	Four lines and under (single col.)	[illegible]	[illegible]	[illegible]

Single Advertisements from the country must be accompanied with cheques in payment.

THE TELEGRAPHIC JOURNAL.

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ON RAILWAY ELECTRIC SIGNALLING.

By W. H. Preece, Assoc. Inst. C.E.

(*Continued from page* 256.)

It will readily be perceived how completely this apparatus fulfils the third point detailed as a desideratum for a signalling telegraph. The man at one station has the sole and complete control over the signal at the other station, and it is impossible for him to interfere with or alter the signal in his own box. It is true that he can depress the signal with his finger, but it instantly flies back. He can tie the arm down with string, but there are acts of malice and wilfulness which no human foresight can totally remedy, but which careful arrangement can render innocuous. He cannot interfere with or alter his own signal by any movement of his own apparatus, or any accidental disturbance of his instruments. The "all clear" signal can *only* be given by the man at the other station.

To prevent the possible tampering of the signal with the hand, some instruments have been securely encased in glass, but this takes away one of their distinctive characteristics—their similarity to the signals on the line—and removes considerable responsibility from the signalman in exercising care and attention in maintaining his instrument clean and in good order. One great object that I have had in view has been the construction of an instrument which any intelligent signalman can comprehend. There is no reason why an ordinary signalman should not fully understand and attend to the instrument under his charge. He cleans his own lamps, oils his own signals, adjusts his own wires, and there is no reason why he should not do the same with his signalling instrument. As a rule, these men have plenty of shrewd sense; their intelligence is generally underrated. I have found in the majority of cases that signalmen immediately comprehend these semaphore and disc instruments. They become attached to them; they keep them in order, and, as a necessary consequence, they never fail. This is rarely, if ever, the case with needles and other instruments. I therefore place the semaphore under the charge of the signalman, and discard all glass cases. Glass cases are also presumed to be useful in maintaining the interior of the instrument free from dust and dirt, but dust and dirt are amply secured against by close-fitting brass slides and ebonite plinths to the post or pillar.

I have remarked that it is possible for a man to tie his signal down by a piece of string. It is also possible for him to neglect his duty, to disregard his signals, and to swear that the semaphore was down when it was really up. Every instrument employed in carrying on the business of a railway depends upon human action, discretion, or judgment; and when drivers are found so reckless as to rush past their signals, when pointsmen are discovered so wicked or so absent as to turn points the wrong way, when signalmen are so malicious or careless as to show "all clear" when they are instructed to give "danger," no efforts of thought, no dictates of reason, no inventions of genius, will obviate accident and produce safety. The principle that is adopted to mitigate the evils arising from the fallibility of human power upon railways, is to arrange matters so as to secure safety by the mutual and independent action of two or three different individuals leading by separate routes to one result; hence, before a driver can start his train, the station-master must ring the bell, and the guard must blow his whistle; hence, also, the safety of the train staff on single lines, where the consentaneous mistake of three men must occur before collision can arise, viz., the station-master who has charge of the staff, the guard who receives it, and the engine-driver who could not move without it. The same principle has been introduced into electric signalling, where it requires two men totally disconnected from each other to make the same error, and two instruments to fail at the same moment, to endanger the safety of the line. This is accomplished by arranging that every signal shall be properly acknowledged and repeated, and that the acknowledgment shall not only imply the due receipt of the signal sent—that the instrument has acted properly—but that it has been correctly understood and properly acted upon. This forms the fourth requirement of an electric signalling system, which will now be discussed. It is a most important point, and one upon which the whole safety of electric signalling depends. It not only secures safety, but it compensates for the loss of sight, and satisfies the mind that everything has acted properly at a distance as completely and as satisfactorily as the eye does when the same action occurs within view.

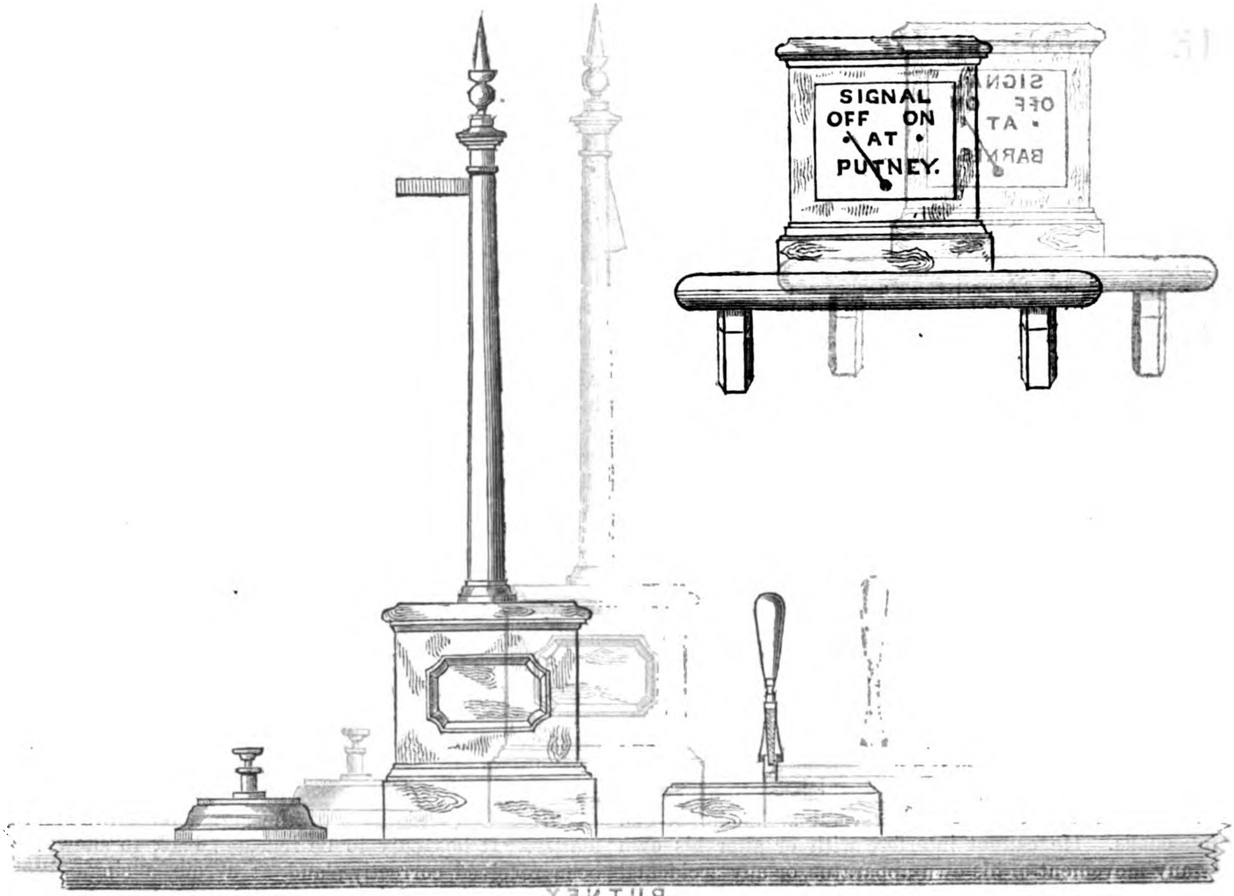
The acknowledgment of the signal on the bell is a simple matter. It has only to be repeated back to show that it has been received correctly; and, as a rule, a single beat is considered amply sufficient as an acknowledgment signal. It is, however, with the "all clear" and "danger" signals that care is necessary, repetition compulsory, and acknowledgment essential. A certain and positive knowledge that a signal has acted correctly is held to be so important by railway companies, that repeating signals, bells rung mechanically, &c., are invariably fixed when signals are unavoidably fixed out of sight. If this is held to be so important when the signal is close at hand, how much more important must it be when at a distance! Hence the greatest care has been taken in electric signals to secure repetition. Now it has been ordered that every signal received must be acknowledged, and that no signal is to be considered complete until it has been acknowledged. This acknowledgment not only implies the receipt of the signal sent, but it shows that the semaphore has acted properly, and that it is fully understood. To fully understand the action of this part of the apparatus, I append a diagram (Fig. 8, on following pages), showing the instruments fully fixed for service inside two signal-boxes at two stations, which I have called Putney and Barnes—where, indeed, they are in operation.

The semaphore at Putney, with the bell key on the one and the switch on the other side, is fixed upon the counter. The bell is placed upon a bracket above them. The same occurs at Barnes.

The wires are not shown in this diagram, because they tend so much to complicate the illustration. Suffice it to say, that the plungers and bells are fixed on one wire called the "bell wire." The semaphore at Barnes and switch at Putney on another wire, called the "Up-line wire;" and the semaphore at Putney and switch at Barnes on the the third wire, called the "Down-line wire."

It will be observed that upon the front of the case of the bell at Barnes there is fixed an indicator, which points alternately to "signal ON or OFF at Putney,"—shown on a larger

FIG. 8.



BARNES.

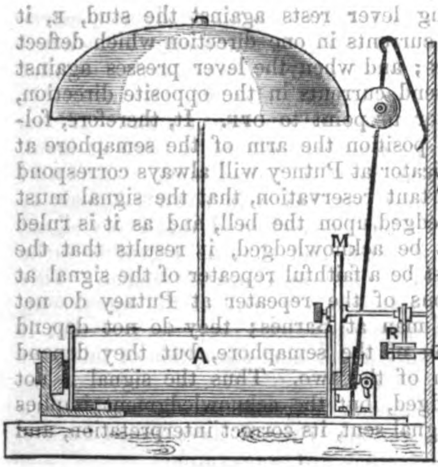


FIG. 9.

FIG. 10.

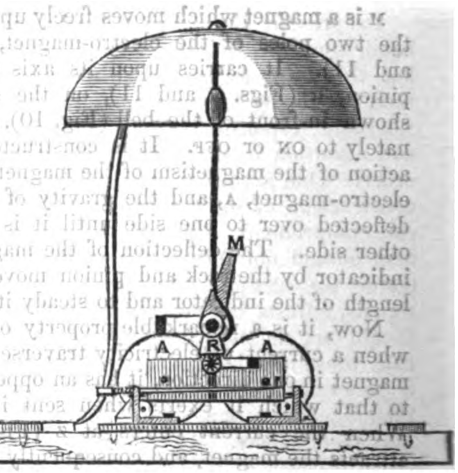


FIG. 11.

scale in Fig. 10. Now, this indicator is a faithful repeater of the signal at Putney, and it is used for no other purpose. It always indicates to the signalman at one station the condition of the signal at the other station, and always informs him of his signal having acted correctly. The contruction and details of this repeating apparatus are fully shown in Figs. 9, 10, and 11, which are respectively a side elevation, a front view of the face, and a front elevation with the face removed of the bell described in Fig. 1, but with the covering in each case taken off, and the addition of the indicating arrangement.* The principle upon which this indicator acts is more clearly shown in the following sketch (Fig. 12).

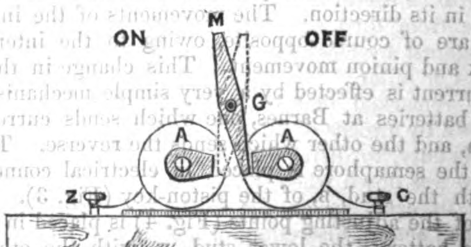
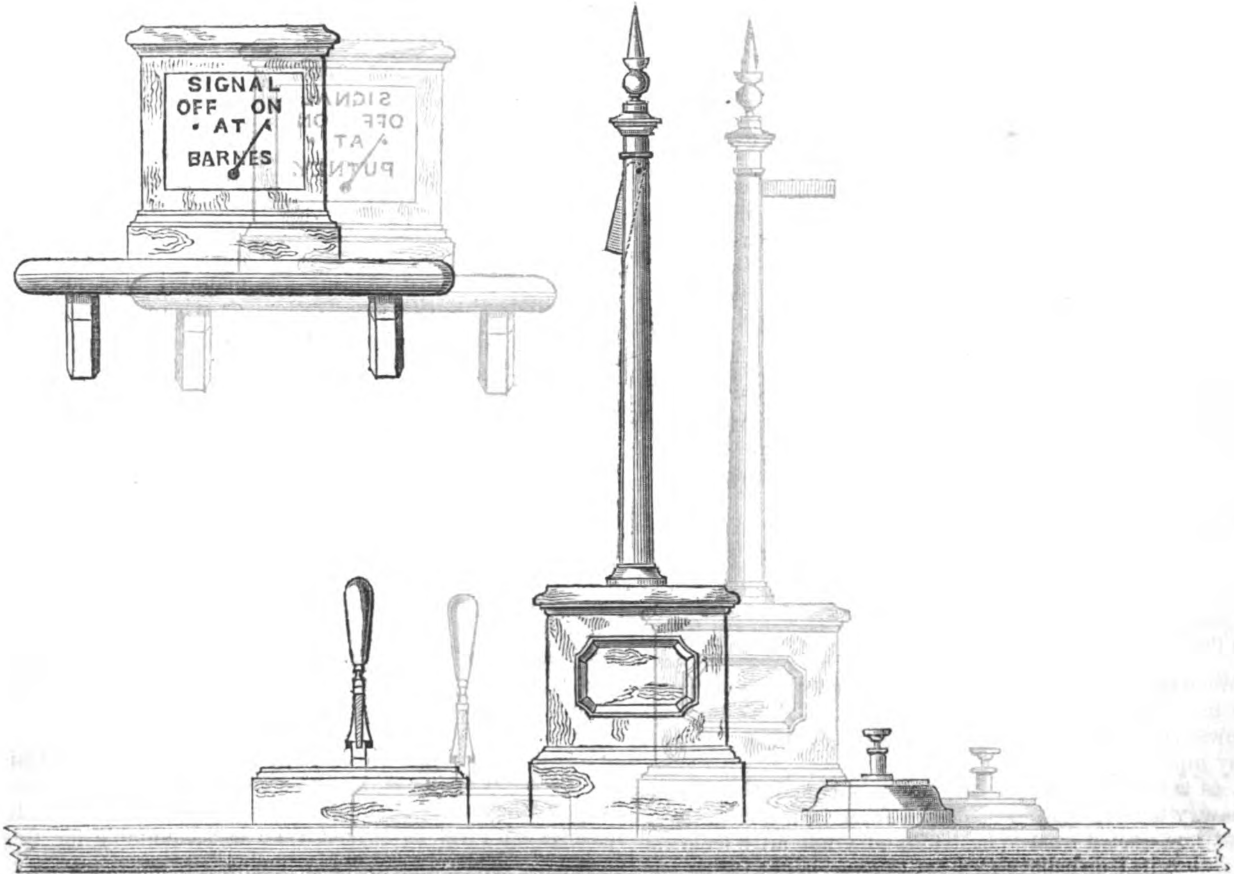


FIG. 12.

* All the illustrations in this paper, with the exception of Fig. 8, are drawn to the same scale, viz., one-third of the full size. Fig. 8 is one-sixth of the full size.

Fig. 8.



PUTNEY.

M is a magnet which moves freely upon the centre, G, between the two poles of the electro-magnet, A A, of the bell (Figs. 9 and 11). It carries upon its axis a rack, which works a pinion, R (Figs. 9 and 11), on the spindle of the indicator, shown in front of the bell (Fig. 10), and which points alternately to ON or OFF. It is constructed so that by the mutual action of the magnetism of the magnet, M, upon the iron of the electro-magnet, A, and the gravity of the indicator, it remains deflected over to one side until it is sent back again to the other side. The deflection of the magnet is transferred to the indicator by the rack and pinion movements, R, to increase the length of the indicator and to steady its movements.

Now, it is a remarkable property of electro-magnetism that when a current of electricity traverses the wire of the electro-magnet in one direction, it has an opposite effect upon a magnet to that which it exerts when sent in the contrary direction. When the current enters at Z (Fig. 12) and exits at C, it attracts the magnet, and consequently the indicator, over to ON, and it will remain pointing to ON as long as currents continue to be sent in that direction. But the moment the direction of the current is changed, the indicator flies over to OFF, and remains deflected in that position until the current is again changed in its direction. The movements of the indicator and magnet are of course opposite, owing to the interposition of the rack and pinion movement. This change in the direction of the current is effected by a very simple mechanism. There are two batteries at Barnes, one which sends currents in one direction, and the other which sends the reverse. The rocking lever of the semaphore is placed in electrical connection by a wire with the stud, B, of the piston-key (Fig. 3). The upper stud, E, of the adjusting points (Fig. 4) is placed in connection with one battery, the lower stud, F, with the other battery. Now, when the rocking lever rests against the stud, E, it enables the key to send currents in one direction which deflect the indicator over to ON; and when the lever presses against F it causes the key to send currents in the opposite direction, which cause the indicator to point to OFF. It, therefore, follows that in whatever position the arm of the semaphore at Barnes may be, the indicator at Putney will always correspond with it, with this important reservation, that the signal must have been first acknowledged upon the bell, and as it is ruled that every signal must be acknowledged, it results that the indicator at Putney must be a faithful repeater of the signal at Barnes. The indications of the repeater at Putney do not depend solely upon the man at Barnes; they do not depend upon the solitary action of the semaphore, but they depend upon the mutual action of the two. Thus the signal is not only properly acknowledged, but the acknowledgment implies the due receipt of the signal sent, its correct interpretation, and its proper instruction.

This important fact, therefore, follows, that to produce a false signal, and imperil the safety of the line, the man at Barnes must make a mistake, the semaphore at Putney must fail to act, the man at Putney must neglect his duty, and the bell and indicator at Barnes act improperly, all of which acts occurring simultaneously is far beyond the bounds of the doctrine of probabilities.

(*To be continued.*)

To Prepare Iodide of Cadmium.—Dr. Vogel says:—"Dissolve twenty-six parts of iodide of potassium and fifteen parts sulphate of cadmium in water, and condense. Heat the residue with absolute alcohol, whereby iodide of cadmium, which is easily soluble in alcohol, is separated from the sulphate of potash."—*Photographische Mittheilungen.*

"CHEROKEE" TO UNCLE SAM.

My dear uncle will excuse my delay in replying to him earlier, as he will doubtless guess that I may have been on an expedition taking scalps, as is the wont of "slashing Red Indians."

I fully agree with my uncle that f represents the strength of the current of a voltaic circuit or battery after the internal resistance of the battery is overcome.

I also agree with Wheatstone when he says, "The electromotive force of a voltaic circuit varies with the number of elements, and the nature of the metals and liquids which constitute each element." * * * * So that you see Mr. Wheatstone calls f the *electro-motive force* of a battery or circuit, composed of a "number of elements." And my uncle calls it the "*strength* (intensity) *of the current*." And I agree with them both by turns. I am no stickler for names; only if you give a thing a name stick to it.

It is the remaining part of Mr. Wheatstone's "*Law*" that I disapprove of, as not agreeing with his formula—namely, "* * * *; but is in no degree dependent on the dimensions of any of its parts."

I will state the formula again,

$$\text{“}f=\frac{nE}{\frac{nRD}{S}},$$

E, electro-motive force; R, resistance; D, distance between the plates; S, area of the plates in contact with the liquid."

Mr. Wheatstone tells us, as above quoted, that no matter how S varies, the value of f does not vary. I think any one who knows what simple division means will say it does. Am I right, my uncle?

That, as to the disagreement of the formula and Mr. Wheatstone's law, which is said to be drawn from it, my uncle says, "the first law quoted from Wheatstone may not arise from the formula;" but if I disbelieve *it*, I am to experiment for myself, and I shall find *it* true. Now, Mr. Wheatstone says his verbal law does agree with the formula, for it is drawn from the formula; and all I say is, that it does not. And my uncle seems to agree with me in the above quotation.

I never said that I disbelieved that this formula embodied a law, and that this law was true. I believe it does nearly express the work a battery can do. But Wheatstone's verbal law contradicts it, and my poor uncle does not see the contradiction.

I do not deny that the second law is true. I merely say it is "clumsily" expressed. My uncle thinks otherwise—*degustibus non est disputandem.* "Thus," says my uncle, "the first difficulty vanishes when the law and the formula are correctly stated." Of course it would, my uncle; but then "the law and the formula" are not correctly stated or they would agree, and that is what I find fault with. Oh, Sammy, Sammy! what *are* you dreaming about?

The next question, as to whether a battery will always do more work when the external and internal resistances are equal or not. My uncle is quite in the clouds again. I will restate what I said on that matter more explicitly. Given a constant external resistance, and assume that it is greater than the internal. Then, to bring up the internal resistance to the external, you must increase R or D, or both. Say we must double D to make the resistances equal. And it is said that the power of the battery to do work, or f, is increased by this operation. Let us see. First,

$$f=\frac{E}{\frac{RD}{S}},$$

when the external resistance is greater, and when we change D into 2 D to make the internal resistance equal to the external, it is said we have increased f. Now I say, and common sense says (an expression my uncle likes), that we have halved f, or made the power of the battery to do work just half what it was before, for $\frac{E}{\frac{2(RD)}{S}}$ is just half $\frac{E}{\frac{RD}{S}}$; let the multiplier 2 be any general quantity, p, and of course the result will be a diminution of power to do work. There is another condition which the Doctor has dropped out of his statement, and my uncle does not see it. With that condition the statement would approach the truth somewhat, and would then have called for no remark from me, and there would have been nothing for "my uncle" to fumble in the dark to correct.

In the next place, "my uncle" confesses he does not see what is wrong. I believe you, my wee mannie! Let me restate it. We will begin with the Doctor, or with whom ever else is responsible for it, where it is stated that $\frac{E}{R}$ represents one element or cell, and $\frac{nE}{nR}$ represents n elements or cells; by the way, I hold this as absurd and untrue; but at present it is the external resistance that is in question—namely, that a resistance, m, will lessen $\frac{E}{R}$ more than it will $\frac{nE}{nR}$, although $\frac{E}{R}=\frac{nE}{nR}$; but the Doctor says that $\frac{E}{R}-m<\frac{nE}{nR}-m$, and my uncle agrees with him.

The proper way to state this is, $\frac{E}{mR}<\frac{nE}{mnR}$; but it does not make the slightest difference, as the formula is stated to begin with. Resistances act on currents in geometric ratios, and not arithmetic; but either would do in this instance to show the absurdity, and the arithmetic is the simpler. Even this would approach the truth if the formula was properly stated, and it is the statement of it that I find fault with.

Passing over the grave fault in "my uncle," wishing to change the meaning of his expressions to suit his emergencies, though I hold that R should always mean the same as R; but he does not; yet he says, "Who is accountable for this confusion?" I merely say, "My uncle!"

My dear uncle, I am not laughing at you with my algebraical puzzle. I am simply in a fix. Will you help me out?

THE TELEGRAPH LINES IN INDIA.

From the very interesting report of the Committee of the Kurrachee Chamber of Commerce for 1863-4 we obtain the following particulars of the working of the telegraph lines in India:—

"Second only in importance to an efficient mail service is efficient telegraphic communication; and your committee regret to have to state that there has been no appreciable improvement during the year in the working of the telegraph between Kurrachee and other parts of India. In the last report of the committee allusion was made to the efforts of the Commissioner in Scinde to arouse the Supreme Government to the necessity for prompt and immediate action with regard to the state of the Electric Telegraph Department throughout India. These efforts have been continued during the year just passed, and a letter has been addressed by Mr. Mansfield to the Government of Bombay, pointing out that in eight months, from 1st October, 1862, to 31st May, 1863, telegraphic communication on the Scinde lines had been interrupted *eighty-eight times*, consuming a period of 116 days out of 243. The repeated remonstrances of the Commissioner in Scinde appear to have to some extent produced the desired effect. His letters and statistics were forwarded for report to the Director-General of Telegraphs, and on the 28th January last we find the Secretary to Government informing Colonel Douglas, in reply to his report, that Mr. Mansfield 'appears to have had good ground for complaint.' While it is matter for much regret that the Supreme Government should have been allowed to remain under the impression that the mischief occasioned by a mistaken system of centralization, and by false economy on the part of the Director-General, was attributable to a subordinate officer who is not on the spot to defend himself, it is highly satisfactory to find that the Governor-General in Council has been apparently at last awakened to the magnitude of the evil, and has expressed himself so strongly on the subject. That the Government have been so awakened is apparent from a [illegible]

5th May, 1864, from the Secretary to Government, Bombay, and addressed to the Secretary of the Chamber, inquiring whether the working of the Telegraph Department has, during the last twelve months, improved. The Secretary replied, embodying the opinions of the committee.

"It is much to be hoped that the matter will not now be allowed to drop. It is perhaps doubtful if the Chamber of Commerce can at present do more than they have done; but it remains to be seen whether their oft-repeated remonstrances, supported as they have been by the local Government, will produce the desired effect. The rapidly approaching completion of the telegraph to England, viâ the Mekran coast and the Euphrates valley, will, as has already been pointed out, soon render the line between Kurrachee and Bombay one of the most important in India; and unless the mercantile community and the Government of Bombay are prepared to see urgent telegrams of English news remain for an indefinite period in Kurrachee, owing to the inefficiency of the line, it is evident that a radical change must be at once inaugurated. The matter is important to Kurrachee, but it will soon be infinitely more so to Bombay.

"While on the subject of the telegraph it may be remarked that the commercial messages formerly supplied by Government have been discontinued during the year. An arrangement, however, has been entered into with the Bombay Chamber, by which copies of late telegrams received by them are forwarded to Kurrachee on the arrival of the Galle and Bombay mails. The utility of these telegrams has, however, been much impaired by the length of time they take in transmission, and the frequent mutilations to which they, in common with other messages, are subjected."

Comment on the foregoing report would be superfluous; all we have to say with regard to the matter is, "O, reform it altogether."

REPORT ON STANDARDS OF ELECTRICAL RESISTANCE.

(Concluded from page 247.)

It has already been shown that C and S can be obtained in absolute measure; hence the second member of equation (8) contains no unknown quantities, and, by the experiment described, the absolute resistance (R) of a wire might be determined. One curious consequence of these considerations is, that the resistance of a conductor in absolute measure is really expressed by a velocity; for, by equation (8), when $SL = C$ we have $R = V$, that is to say, the resistance of a conductor may be expressed or defined as equal to the velocity with which it must move, if placed in the conditions described, in order to generate a current equal to the product of the length of the conductor into the intensity of the magnetic field; or more simply, the resistance of a circuit is the velocity with which a conductor of unit length must move across a magnetic field of unit intensity in order to generate a unit current in the circuit. Moreover it can be shown that this velocity is independent of the magnitude of the fundamental units on which the expression of the magnetic intensity of the field or strength of the current is based, and hence that electrical resistance really is measured by an absolute velocity in nature, quite independently of the units of time and space in which it is expressed. By equation (8) we have

$$C = \frac{VSL}{R}, \text{ but by equation (1) } C = \frac{E}{R}, \text{ hence}$$

$$E = VSL; \qquad (9)$$

that is to say, the electromotive force produced between two ends of a straight conductor moved perpendicularly to its own length and to the lines of force of a magnetic field is equal to the product of the intensity of the field into the length of the conductor and the velocity of the motion; or, more simply, the unit length of a conductor moving with unit velocity perpendicularly across the lines of force of a magnetic field will produce a unit electromotive force (or difference of potential) between its two ends. This was by Weber made a fundamental equation, in place of equation (3), first shown by Thomson and Helmholtz to be consistent with Weber's electromagnetic equation. These simple and beautiful relations between inductive effects and the simple voltaic effects first described are well adapted to show the rational and coherent character of the absolute system.

The experiment last described, as a method of finding the absolute resistance of a conductor by measuring the velocity of motion of a straight wire, would be barely practicable; but it will be easily understood that we can, by calculation, pass from this simple case to the more complex case of a circular coil of known dimensions revolving with known velocity about an axis in a magnetic field of known intensity. Weber, from these elements, determined the absolute resistance of many wires; but this method requires that the intensity of the magnetic field be known; and the determination of this element is laborious, while its value, for the earth at least, is very inconstant. A method due to Professor Thomson, by which a knowledge of this element is rendered unnecessary, has therefore been adopted in the experiments of the sub-committee at King's College. In this plan a small magnet, screened from the effect of the air, is hung at the centre of a revolving coil, which is divided into two parts to allow the suspending fibre to pass freely.

By calculation it can be shown that when the coil revolves round a vertical axis, the couple exerted on a magnetic needle of the moment ml, when deflected to the angle d, will be

$$\frac{L^2 VH}{4k^2 R} ml \cos d.$$

The equal and opposite couple caused by the earth's magnetism will be $Hml \sin d$. Hence

$$\tan d = \frac{L^2 V}{4k^2 R}$$

or

$$R = \frac{L^2 V}{4k^2 \tan d} \qquad (10)$$

an equation from which the earth's magnetic force and the moment of the suspended magnet have been eliminated, and by which the absolute resistance (R) can be calculated in terms of the length, L, the velocity, V, the radius, k, and the deflection, d. The resistance thus calculated is expressed in electromagnetic absolute units, because equation (10) is a simple consequence of equations (1), (3), and (5)—fundamental equations in the electromagnetic system. The essence of Professor Thomson's method consists in substituting, by aid of the laws of electromagnetic induction, the measurements of a velocity and a deflection for the more complex and therefore less accurate measurements of work and force required in the simple fundamental equations. But, however simple in theory the method may be, the practical determination of the absolute resistance of a conductor by its means required great care and very numerous precautions,—some of an obvious character, while the need of others only became apparent during the course of the experiments.

The apparatus consisted of two circular coils of copper wire, about one foot in diameter, placed side by side, and connected in series; these coils revolved round a vertical axis, and were driven by a belt from a hand-winch, fitted with Huyghens' gear to produce a sensibly constant driving-power. A small magnet, with a mirror attached, was hung in the centre of the two coils, and the deflections of this magnet were read by a telescope from the reflection of a scale in the mirror. A frictional governor controlled the speed of the revolving coil. The details and a drawing of the apparatus are given in an Appendix and a plate at the end of the Report*; but a short account may fitly be given here of the points of chief practical importance, the difficulties encountered, and the improvements still desirable.

It is essential that the dimensions of the coil be very accurately known, that the axis round which it revolves should be truly vertical, and that, except in the coil itself, no currents affecting the position of the magnet be induced in any part of the apparatus. To measure the angular deflection the distance of the scale from the mirror is required, and the scale must be truly parallel to the mirror when the magnet is undeflected, or, in other words, when the coil is at rest. All these conditions were fulfilled without difficulty; but the scale by the reflection of which the deflections were measured was, towards the end of the experiments, found not to be very accurately divided; and although a correction for this inaccuracy has been applied in the calculations, an improvement can in future experiments be effected by the use of a more perfect scale. The magnet was suspended by a single silk fibre, eight feet long, inside a wooden case, and by suitable adjustments was brought very carefully to the centre of the coils. The whole suspended system was so screened from currents of air, and so well protected from vibration, that when the coil revolved at its full speed of 350 revolutions per minute, the reflection in the mirror was as clear and undisturbed as when the coil was at rest. The torsion of the long fibre was determined by experiment, and the slight necessary

* The Appendices to this Report will be reproduced in these columns hereafter.

corrections applied in the calculations. The Huyghens' gearing for the driving hand-winch was somewhat roughly constructed, and could certainly be improved; nevertheless there was little difficulty in maintaining a sensibly constant driving-power for twenty minutes at a time. The speed of the coil was controlled by a frictional governor of novel form, designed by Mr. Jenkin for another purpose, and lent for the experiments in question. The action of this governor, combined with that of the driving-gear, was such that in many experiments the oscillations in deflection due to a change of speed were not so great as those due to the passage of steamers in the river when all parts of the apparatus were at rest; so that the deflections during twenty minutes could be quite as accurately observed as the slightly imperfect zero-point from which they were measured. Still better results are expected with a larger governor, made specially for the apparatus, on the joint plans of Professor Thomson and Mr. Jenkin. The oscillations produced by the passage of steamers on the Thames at no great distance from the place of experiments were of very sensible magnitude; and although by carefully observing the limit of every oscillation during every experiment the error due to this cause was in great part eliminated, it is desirable that any future experiments should be conducted in some spot free from all local magnetic disturbance.

The speed of the coil was determined by observing on a chronometer the instant at which a small gong was struck by a detent released once in every hundred revolutions. Mr. Balfour Stewart's skill in this kind of observation enabled him thus to determine the velocity with great accuracy, especially as the observations frequently lasted for twenty minutes without material alteration in the speed.

Some error was apprehended in the necessary measurement of the length of the copper wire used, owing to the extension that would be caused by the strain usually required to straighten the wire. This really serious difficulty was eluded almost by accident, in a manner amusing from its simplicity. At the conclusion of the experiments, the wire to be measured was uncoiled in the museum at King's College, and lay in awkward bends on the planked floor. The straight planks formed an obvious contrast to the crooked wire, and a joint between the planks was found where the opening was just sufficient to hold the wire when pushed into this little groove. Held in this way, the wire when measured was quite straight, and yet was never stretched.

No other measurements than those already described are required by the simple theory; but this theory, as hitherto stated, stands in need of various slight corrections. The currents induced by the earth's magnetism are modified by the currents induced from the little suspended magnet, and also by the induction of the coil on itself. The force deflecting the magnet is also modified by the lateral distance of the coils from the vertical axis. An elaborate analysis of the corrections required on these grounds was made by Professor Maxwell; and to allow of these corrections, the moment of the suspended magnet was measured, and the position of every turn of the copper coil carefully observed. An experimental determination of the induction of the coil on itself, by a method due to Professor Maxwell, agreed with the calculated correction within one quarter per cent.

The resistance of the copper coil measured by these laborious experiments varied each day, and during each day, according to the temperature; and, moreover, this temperature could at no time be determined with sufficient accuracy. It was therefore intended that at each experiment a small German-silver coil, at a known temperature, should have been prepared exactly equal in resistance to the copper coil during that experiment, and these small coils were to have been kept as permanent records of the resistance of the copper coil on each occasion; but this resistance was found to vary so rapidly that the little copies could not be accurately adjusted with sufficient rapidity, and the resistance of the copper coil was therefore simply measured at the beginning and end of each experiment, in terms of an arbitrary unit. This proportional measurement was made with rapidity and precision by a new method, which, it is believed, is superior to the usual plan depending on the division or calibration of a comparatively short wire in the Wheatstone balance.

One unforeseen difficulty was caused by the change of direction of the earth's magnetic force during each experiment. Our method is indeed independent of the intensity of the earth's magnetism, but depends essentially on its direction, since it depends on the value of a deflection from the magnetic meridian. When this source of error was discovered by the continual and gradual change of zero observed, the absolute time of each experiment was noted, and a continuous correction obtained from the contemporaneous records at Kew, which agreed closely with the total changes observed at the beginning and end of each experiment. As the change of zero frequently reached three or four divisions in the course of the day, and as the whole deflection seldom exceeded 300 divisions, the importance of this correction is apparent.

The presence of stationary masses of iron does not affect the experiments injuriously, so long as the uniformity of the magnetic field in which the coil resolves is undisturbed—a point carefully tested before the experiments began; but a change in the position of iron in the neighbourhood during any experiment produces a corresponding error in the result, and the serious effect of moving very small masses of iron at a great distance from the coil was only fully appreciated in the later experiments.

When it is considered that the method described is the simplest known, the discrepancy between the few determinations hitherto made in absolute measurement will cause no surprise. The time, labour, and money required could hardly be expected to be given by any one person, and in researches of this kind the value of the co-operation secured by the committees of the Association is especially evident.

The absolute unit of the sub-committee is about eight per cent. larger than the unit as derived from a German-silver coil lately measured by Professor Weber. It is about six and a half per cent. larger than the unit as derived from a value published by Professor Weber of Dr. Siemens's mercury units. It is about five per cent. smaller than the unit as derived from coils issued by Professor Thomson in 1858, based on Jacobi's standard and a previous determination by Professor Weber. It is about five per cent. smaller than Thomson's determination from Joule's silver wire. It agrees most closely with an old determination of a copper standard made by Weber for Professor Thomson, which it exceeds by only a very small fraction.

The experiments of the sub-committee agree much better than the above one with another. Owing to the gradual improvement in the method and apparatus, the experiments of the last three days are alone considered satisfactory. On the first day the maximum deviation in six distinct experiments from their mean result was 2·4 per cent. On the second day the maximum deviation in four experiments from their mean was 1·3 per cent. On the third day the maximum deviation in five experiments from their mean was 1·15 per cent. The maximum deviation in the means of the three days' experiments from the mean of the whole is only four-tenths per cent.

These results are not unsatisfactory, and are perhaps more accurate than any measurement yet made of the relative values of heat and work—a measurement corresponding to a great extent in its nature with that undertaken by the committee. Nevertheless, considering the discrepancy of the various independent results, the committee are of opinion that it is essential that the results of the sub-committee should be checked by a fresh series of experiments with a new coil in a distinct place, when every separate measurement will necessarily be repeated. The sub-committee especially urge the repetition of the experiments, as with the improvements already enumerated, and other minor alterations, they confidently expect a considerably closer approximation to the absolute unit than they have hitherto obtained. It will be well here to remark that, according to the resolution of the committee of 1861, the coils, when issued, will not be called absolute units, but the units of the British Association; so that any subsequent improvement in experimental absolute measurement will not entail a change in the standard, but only a trifling correction in those calculations which involve the correlation of the physical forces.

It is now time to leave the question of absolute measurement, and pass to some of the other points under the consideration of the committee. Dr. Matthiessen has, by careful experiment, proved the permanence for a year at least of the electrical resistance of certain wires; but he has detected a change in others, due, apparently, to the influence of time. Certain specimens of silver, gold, and copper have varied; but other specimens of the same metals have remained constant. All the specimens of platinum and gold-silver alloy have remained constant, and all the specimens of German-silver have changed considerably. It is proposed to continue and extend these experiments, and it is much to be hoped that the defect observed in the German-silver tested will not be found common to all the varieties of this alloy, in other respects so well adapted for the construction of resistance-coils. Dr. Matthiessen found no difference in the resistance of wires of any of the above metals before and after the passage of a powerful

current transmitted through them continually for a fortnight. Dr. Matthiessen has also continued his experiments with the object of finding an alloy with a minimum variation of resistance due to change of temperature, but has been unable to produce a wire superior in this respect to the silver-platinum alloy mentioned in Appendix A of the Report of last year, as decreasing in conducting power 3·1 per cent. between 100° and 0° Centigrade. German-silver was found to decrease under the same circumstances 4·4 per cent.

The valuable experiments of Mr. Sabine, for Dr. Werner Siemens, of Berlin, on the reproduction of standards by means of mercury, although not undertaken for the committee, yet bear so directly on the subject before them that the results cannot be allowed to pass unmentioned. Dr. Siemens has conclusively proved that he can, in his laboratory, reproduce a standard by means of mercury with an error of less than 0·05 per cent. This admirable result, while it seriously affects the question of the best material for the construction and reproduction of the standard, leaves, of course, the question of the best magnitude for the standard quite untouched. Dr. Matthiessen thinks that several of the solid metals are equally fitted for the purposes of reproduction, and, if aided by the Association, is disposed to put his conviction to experimental proof. It is especially desirable that the various methods proposed should be tested by the concordance of the results obtained from a number of independent observers.

With reference to the construction of the material standard, it is proposed that the British Association units shall be represented by several equal standards made of the different metals, which, so far as our limited experience goes, show the greatest signs of constancy. Two at least of those stands would be made of mercury, in the manner proposed by Dr. Siemens. The permanent agreement between several of these standards would afford the strongest possible proof of their constancy.

Passing to other electrical measurements, the committee have to report that Professor W. Thomson has successfully constructed a material standard gauge by which electromotive force or difference of potentials can be directly measured. This instrument is founded on a measurement of the electrical attraction exerted on a small moveable portion of a large conducting-plane by another large parallel plane fixed at a constant distance, and electrified to a different potential. The force exerted is ultimately measured by the torsion of a platinum wire; but the difference of potential corresponding to any one gauge is simply indicated by the motion of an index to a sighted position. If the planes are brought sufficiently close, with a given torsion in the platinum wire, the moveable piece will be in a condition of unstable equilibrium when its index is in the sighted position, but if moved to a greater distance the equilibrium will be stable; hence, by a correct choice of the distance between the two planes, or initial torsion in the platinum wire, as compared with the difference of potential to be measured, any required delicacy of indication is obtained. The constancy of the gauge, like that of all standards, depends simply on the constancy of the materials of which it is constructed, and there is no reason to apprehend any special difficulty in the present case.

Professor Thomson has also on the same principle constructed an electrometer in which the distance between the parallel planes is made variable, and is adjusted by a micrometer-screw. The plane conductor, of which the small moveable index forms part, is in this instrument permanently maintained at a high potential by connexion with the inner coating of a Leyden jar, and the other plane is connected with the body to be tested. Calculation, confirmed by experiment, shows that in these instruments the difference of potentials between any two bodies, successively tested, is directly proportional to the difference of the distances between the parallel planes required in each case to bring the index to its sighted position. This difference of distance is the same whatever be the charge of the Leyden jar, provided only it remains constant during the comparison of the two bodies. With this limitation, the indications of the instrument may be called independent of the charge of the Leyden jar. There can be little doubt that gauges of electromotive force and electrometers, fulfilling the above conditions, will shortly become as necessary to all practical electricians as standards of resistance and sets of resistance-coils.

No progress has been made in the measurement of currents, and much remains to be done in this respect. The method already described, depending on the use of a tangent galvanometer, requires a knowledge of the horizontal force of the earth's magnetism, and is, therefore, in most cases beyond the reach of observers where greater accuracy is required than can be obtained by taking their value from the scientific almanacks. Next year it is hoped that this want may be remedied, and the present Report may fitly conclude by the enumeration of objects to be pursued by the committee, if re-appointed at the present meeting:—

1st. The experiments on the determination of the absolute unit of resistance will be continued.

2nd. Immediately on the conclusion of these experiments, equal standards, constructed of such metals as promise the greatest constancy, will be deposited at Kew, where the permanence of their equality will be rigorously tested.

3rd. Unit resistance-coils of the best known construction will be issued to the public.

4th. The experiments already begun on the permanence of the electrical resistance of wires and alloys under various circumstances will be continued and extended.

5th. The experiments on the reproduction of standards by chemical means will be continued.

6th. Experiments on the best construction of gauges of electromotive force or difference of potential, and on electrometers, will be continued.

7th. A standard galvanometer, for the measurement of currents in absolute measure, will be constructed, and electro-dynamometers for the same purpose compared with the standard instrument, and issued to the public.

8th. Experiments on the ratio between the electrostatic units and the electromagnetic units will be undertaken.

9th. Experiments will be made on the development of heat in conductors of known absolute resistance with currents of known absolute magnitude. The results of this experiment will give, by equation (3), a new and very accurate determination of the mechanical value of the unit of heat.

The conclusion of the experiments on absolute resistance, and the adoption of the absolute system as the basis of all electrical measurement, will, it is hoped, allow considerable progress to be made in most of these researches.

THE ATLANTIC TELEGRAPH ENTERPRIZE.

By AMICUS.

WE propose to make a few more remarks upon this subject, the vastness whereof, and the amount of success anticipated, will be our measure of excuse.

From this enterprize, as has probably been conjectured, we anticipate a bulk of immortality far outweighing the Olympian bestowments of that agreeable commodity, and compared with which the undying renown of warriors who have deluged whole continents with blood, whether from necessity or choice, is as a shadow that dwindles to the thinnest visible consistency. How many knights, whether one or more, it will please her most gracious Majesty to make out of the concern, it behoveth us not to conjecture; and a sense of modesty forbids our making any allusion as to the number of our esteemed friends who are worthy of the honour, or a specification of the particulars of the unparalleled services upon which such deserts may be fairly grounded. Doubtless, when the whole concern is successfully accomplished there will be a magnanimous display of royal favour, and may it be ours to be the recipients thereof. Our trans-Atlantic friends also will be equally generous in their way. Unfortunately, however, "Old Abe" and his compeers have no honours they can bestow (and this is the great fault of a republican government) that will distinguish us from the common herd of humanity, unless it be a lavish bestowment of greenbacks and an unusual length of new-spun buncombe; but while these small favours will be thankfully received, inasmuch as they will help to swell the dimensions of the aforesaid bulk, we nevertheless cannot be unconscious that to kneel before our sovereign lady, and be commanded by the dearest, and most silvery, and most musical voice that ever trilled over the lips of feminine royalty, "Rise, Sir Somebody Somebody," is the acme of human felicity, and of more value than all that the institutions of republicanism can bestow; and that a decoration whose intrinsic worth is fifty-eight pence sterling, pinned upon our coat by the immaculate apex of an immemorial monarchy of the first water, is a badge of wealth outweighing the coffers of Crœsus, an insignia before which all other honours "pale their ineffectual fires." No offence, Columbians. You are generous enough, we trust, to make allowances for the monarchical proclivities of the Britisher, and

the mania which its glittering paraphernalia produce upon the favoured dwellers beneath its Ægis. We value your friendship, with all its substantial and unsubstantial equivalents; and next to the aforesaid boons of home production, we appreciate to the utmost extent *your* meed of demonstrable hilarious favour that waits upon *our* success.

In our last paper we left the cable, or rather the core, or, more correctly speaking, such parts of the core as were made, safely locked up in huge water-cisterns down at East Greenwich, awaiting the final process of outer sheathing. This baptism by immersion of the core is a very excellent process; the insulation is preserved; and, by repeated testings, opportunities are afforded whereby any latent defect may be discovered which previous tests had failed to reveal; and, moreover, it has the advantage of a gradual initiating of the cable to its native element. O dear! if the Fates would only deal as gently by us! but no, they are capricious; and our joltings and tumbles from scenes and circumstances familiar, to ditto ditto remote and uncongenial, are sudden, impulsive, and dislocative, and not that gentle, gradual transition through the phantasmagoric slides which our slothful soul longeth for. Ah! but when we have done this business, then for the oasis and that ineffable state of content and repose better conceived than described, and which, for the want of an Orientalism, we cannot express.

We have shown clearly (to our satisfaction at least) the superiority of our conductor in quality of metal, construction, and bulk, and think we have been equally happy in our description of the insulation; it remains for us, therefore, to dwell briefly on the plan for external protection which we in our riper wisdom have decided upon. We may just revert to a matter, however, which may possibly be taken exception to by some eminent individuals with whom we should be sorry to be at loggerheads, while at the same time we are nervously anxious to avoid every scientific blunder of omission or commission which can be taken advantage of by the many clever readers of this journal, who would be pleased at the opportunity of impaling us upon the highly-polished shafts of their sarcastic wit. We are young and tender, and have many points, we fear, not yet armour-proof, and therefore have a more wholesome dread of this tall criticism than of Old Squeers' "Birch," or the milder remonstrance of the gentle swain with the euphonistic appellative. It will be said that the conduction of the old cable was not so much nullified by induction as by the resistance of the metal, owing to its inferior quality; but this great obstacle of resistance was implied in our remarks upon the low conductivity of the copper then used. It is manifest if the conductor of the old cable had had a conductivity equal to 85 per cent. of pure copper, instead of some 55 or 60 per cent., it would have been signalled through with much greater ease, assuming there were no vital defects of insulation; but on the supposition that the dielectric had been of the most perfect description, it by no means follows that the resistance of the wire would have presented insuperable obstacles to the working of the cable, although the retardation consequent thereupon rendered it extremely problematical as to its ever being, in a commercial sense, a success. But virtually it remains an open question, which was the greater agent of nullification to the conductivity of that cable, the great resistance of the inferior copper or the high inductivity, the resultant of slovenly workmanship in the application of a very bad quality of gutta-percha. The retardation from the latter cause was, doubtless, the greater of the two. It was increased in several ways, such as the want of uniform centricity of the conductor, where ever and anon a thin film of insulation only separated the copper from exterior influences.

The outer covering of the cable is, doubtless, familiar to every one, and as we proceed the superiority of the one now in process of manufacture will make itself apparent. The core, as being a precious and expensive article, upon the intactness of which the whole concern hinges, is, preparatory to sheathing, carefully embeded in a layer of soft jute yarn, saturated with a preservative compound, the nature of which, for obvious reasons, we do not make known. This yarn is wound round spirally, it being first carefully tested, and every pound rejected that is not found up to the sample in strength and other necessary qualities; this necessarily entails a vast amount of additional work and supervision, which of course entails its equivalent of so much extra expense incurred; but it is considered as money well spent, especially if it be true what some croakers say, that we are going to make the Atlantic a laboratory for a vast experiment on a problem which it were wise to conduct on a smaller scale on account of its great cost.

But here is where we differ from these venerable wiseacres, whom, nevertheless, we profoundly respect; we do not consider we are going to make a vast experiment, except in the general sense of the word, by which everything is to be esteemed experimental that is taken in hand either by nations or individuals—from the making of war to the regulation of the sale of periwinkles.

As observed in our last paper, we mean to go on a safe card, and believe we are doing so; and it is our conscientious conviction that if this cable do not turn out a success, it is simply impossible to span the Atlantic at all. And this we are bold to say is neither egotism nor bombast, but a conclusion to which every impartial individual must arrive, whether interested in the concern or not.

As a further evidence of the determination to do the thing in the best possible way, so as to reduce the chance of failure to a minimum, we may point to the extreme care exercised in the choice of the iron wire for sheathing—its quality, ductility, and strength. Every pound of this enormous mass of metal will be carefully tested, and any portion not up to the high standard required will be summarily rejected, without any regard as to whether the wire-drawers like the process or not. And, perhaps, it may not be out of place here, to refer briefly, and in a general way, to the mechanical properties of this cable as a whole. The choice was not made without due—nay, anxious and prolonged—deliberation—a deliberation, in fact, which we should do well to copy nationally and individually. To Mr. Fairbairn, the first mechanical engineer of the age, we entrusted the making of an extended series of experiments preparatory to deciding upon what description of cable should be adopted; and we take it to be a proof of our advance towards manhood that we had the good sense to do this. This eminent mechanician tested everything in connection with the requirements of a submarine cable with results alike honourable to his well-merited fame, and the vast importance of the enterprise—the well-being of which depended so much upon the correctness and elaborateness of his tests.

The wire is to be of homogenous iron ·095 inch diameter, and with strength sufficient to sustain 1,000 lbs. with scarcely any perceptible elongation; but such elongation as there is improves the quality. And three things are insisted upon in the selection of this wire—a proper care in selection, a judicious system of manipulation, and a rigid system of inspection of the manufacture; a trio of excellent conditions which might apply to a variety of things, and be adopted with general advantage. It seems almost unnecessary to say, because it has been said so many times, that ten of these wires are laid spirally round the padded core, each one being first covered with five strands of Manilla yarn saturated in the aforesaid compound, which is to be nameless. By this means strength is added to the entire cable, while at the same time the outer wires are protected from rust. The entire weight of the cable wants 4 cwt. of being double that of the old one; while the breaking strain, or its capacity for bearing its own weight in water, is rather more than double its predecessor. This cable, suspended we will say, perpendicularly in water, would bear eleven nautical miles of its own weight; the former one broke at about five miles. And it may be fairly assumed, that between Valentia and St. John's, this cable will never be required to sustain more than half its breaking strain.

And what shall we say next? we hear murmured here, there, and everywhere; they all vote iron a mistake, and pray sincerely for the sake of us and them, and those to be, known by the term posterity, that we the metal should abjure because *de facto* and *de jure*, 'tis sure to rust, is cumbersome, and therefore is but so much lumber that will bring to certain grief the cable company and chief. They argue, spiral iron wound however carefully around the core, will, when 'tis paying out, stretch, elongate, and wrap about the hapless core with iron grip; and thus the incubus will slip from off the shoulders that should bear the strain, the weight, the wear and tear, and fall upon the hapless part, and stab the cable to the heart: or, without metaphor, 'twould be a breach of continuity. Or, grant the cable we submerge successfully, they then will urge, "Your cable when it needs repairs, how will you bring it towards the stars? the iron then, without a doubt, all rust will be, inside and out, so that by virtue of the weight of this vast ponderous estate, which to the weak should be protection, will prove to be the great defection; 'twill sever when 'tis grappled, and have no more strength than rope of sand, but hang about in cumbrous mass when through the waters made to pass, until at length th' attenuated core gives up the ghost and sinks for evermore." A lamentable picture this, and one that's drawn not much amiss; but the [illegible] part's imagination, the rest is all exaggeration, which truly we [illegible]

prone to think is hardly worth the thoughts we think. But ere we draw unto a close, let's see what these wise men propose—or some of them; for 'twould our strength exhaust, and spin to a vast length this third and last of our immortal scribble, until our wit, that's wont to stream, would dribble. One says, "Use cane; O it will never rust, and certainly 'twill never turn to dust, on this side doomsday; 'twill not elongate by its own nor by any other weight." Another, "Hemp's the stuff for you, braided and eyeable to view; 'twill last till it's worn out, that's never, and takes a precious strain to sever; 'tis strong, compact, affords the best protection, does not elongate, never kinks in action." A third cries, "Sirs, try my first-class subaqueous cable sheathed with brass; 'tis strong, and durable, and bright; specific gravity is light; 'tis elegant and comely to behold—a line of light, a rope of burnished gold." Wisht, masters! we can hear no more, although there stands another score, each waiting with a spick-span cable, "the best," "the strongest," "most durable." Stay, there's our friend Nautulicus, he something has to say to us; and, to the best of our belief, 'twill be worth hearing: pray be brief. Then Nautulicus—"Worthy sirs, 'twere wise that blunders, bulls, and blurs, in this great enterprize should be avoided ere you put to sea. Old ocean is my element, I on it half my life have spent; and though I'm not so scientific as you, I'm apt to be a critic; and qualified to counsel, too, in matters where the boundless blue is to be sailed or cabled through. Your cable's altogether wrong, 'tis weak where it should be most strong; from centre to circumference it outrages our common sense. If you would guard against disasters, and spare your pockets good, my masters—the strength must in the centre be, and iron be expunged *per se;* the core no covering will require, but have your insulation higher than gutta-percha ere can make it; and to do this you must, I take it, call in friend Macintosh to make it; friend Allan, too, will not forsake it. Adopt this plan, then come to me, and I will pay it out at sea; my cylinder will do it safer than that Great Eastern—luckless chafer!" Thanks, gallant captain, we will wait until we have our cable straight, and then we will appeal to thee and also to the other three. If in your systems there is ought that's worthy of a passing thought, certes 'twill have our due consideration, and you may live to benefit the nation—perhaps the world, as we are doing now: we make you all a deferential bow.

It is quite evident we could not adopt everybody's cable; it is equally evident (to ourselves at least) that we have adopted the best that could be devised; and in this opinion we are so borne out by the testimony and approval of men of eminence, that it is surely unnecessary to insist upon it any further. It is the best possible proof that we telegraphists are rapidly attaining to the experience of a maturer life, and we rest with but few misgivings as to the ultimate result.

The Atlantic Telegraph Enterprize, however, apart from the mechanical considerations of the cable, is a majestic subject, and deserves to be treated in the statuesque style,—we hope to see it so treated ere long.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XVII.

A.D. 1841, July 7.—No. 9018.—Mallet, Robert.—"Certain improvements in protecting cast and wrought iron, and steel, and other metals from corrosion and oxidation, and in preventing the fouling of iron ships or ships sheathed with iron, or other ships, or iron buoys, in fresh or sea water. The specification, amongst other things, mentions the electro-chemical protection of ships "by the contact of zinc according to the plan suggested by Sir Humphry Davy." The improvements consist of:—

A mode of cleansing metals before alloying or coating them with other metals. A method of preserving iron by means of a triple alloy. The use of a varnish, particularly described in the specification, and all analagous compounds, "for the purpose of protecting iron or other metals from corrosion when employed in combination with a coating of the triple alloy" above alluded to, "or when used in combination with a covering of zinc, lead, or tin, or any mixture of these metals." The use of a "zoofagous," or animal-and-vegetable-life-destroying paint (composed of "drying linseed oil," red lead, sulphate of barytes, turpentine, "oxychloride of copper," hard yellow soap, common resin, and a little water) particularly described in the specification, or of any other paint possessing similar properties, either in combination with the triple alloy and varnish above alluded to, or with one of them, or separately, to prevent the fouling of ships, &c. The application of the zoofagous paint to ships, &c., "sheathed with copper and electro-chemically protected by the contact of zinc, according to the plan suggested by Sir Humphry Davy." The application of the triple alloy, the varnish, and paint, to iron or steel articles, and to ships, "whether all three or any two of them are used in combination, or they are used separately." The application of palladium for the purpose of protecting iron or steel.

A.D. 1841, July 7.—No. 9022.—Wheatstone, Charles.—"Improvements in producing, regulating, and applying electric currents," relating to:—1st. "The production of electric currents by means of magneto-electric machines." A magneto-electric machine is described and shown, in which five pairs of coils, fixed on the same axis, revolve between the dissimilar poles of six permanent horseshoe magnets, the axis passing between the poles of the magnets. The coils are fixed in different relative positions, so that "the current in any one coil" commences "before the currents in the other coils have ceased." The terminal wires of each coil are connected to insulated semicircular pieces of metal, inlaid in the axis, and springs always press upon these; by which arrangement an electric current always passes through the springs in the same direction. A proper metallic connection is made between the springs, so as to conduct the nearly continuous current thus produced to suitable binding screws. 2nd. "A means of regulating an electric current by varying the length of the circuit." First method:—A "slide," connected with one circuit wire, includes in the circuit more or less of a wire wound round a wooden cylinder, according to its position by the turning of the cylinder. Second method:—A flexible wire is wound from a wooden to a brass cylinder, or *vice versâ;* the brass cylinder being connected with one circuit wire; the wooden cylinder carries the wire included in the circuit. Third method:—A wire is bent backwards and forwards on the surface of a fixed wooden cylinder, parallel to its axis; the amount in the circuit depending on the position of a spring, moving, from the centre, over studs terminating each double length of wire. 3rd. "A new method of constructing electro-magnets." Insulated copper ribbon is coiled in concentric grooves cut in the face of a soft iron disc, the grooves communicating by a notch. 4th. "New means of arranging the parts of an electro-magnetic engine." Horseshoe electro-magnets are fixed in the circumference of a circle, and a soft iron ring or armature rolls over them; the armature being excentric to the magnets, gives motion to an axis fixed in their centre. Another method:—The axis of a soft iron disc or armature is inclined "to the axis of the circle of the fixed electro-magnets," and works in sockets in the driving shaft at one end, and in a crank attached to the driving shaft at the other end; the axis of the disc "describes the surface of a "cone," and the disc, by rolling over the fixed electro-magnets, gives motion to the driving shaft. The following are modifications of the application of the principle of giving a rolling motion to an armature in an electro-magnetic engine:—The armature may roll over other lines besides a circle; a reciprocating motion may be given by the armatures rolling over the electro-magnets in a straight line backwards and forwards; either electro-magnets or armatures may move; both may be electro-magnets; and separate armatures may be used. 5th. "A new mode of combining the parts of an electro-magnetic engine." The driving shaft carries horseshoe permanent magnets (their poles radiating outwards and disposed alternately) in front of a fixed circular frame supporting electro-magnets at right angles to the permanent magnets, and with their similar poles opposed. By interrupting and reversing the current by means of an inlaid disc alternately connected, called a "rheotrope," motion of the driving shaft is obtained. The coils of the electro-magnets form a continuous single circuit. The following modifications are stated:—Coils may be used instead of electro-magnets; the electro-magnets or coils may be lengthened in the radial direction; electro-magnets may be used instead of permanent magnets; the electric current may pass through all the coils simultaneously; magnetic bars may be used, with similar poles outwards, instead of horseshoe magnets, the coils being then wound in the same direction, and the current merely being interrupted; also any number of circles of magnetic bars and electro-magnets or coils may be used on the same axis; by this means both sides of the magnets and coils (except the exterior ones) are used. 6th. Releasing the "detent" of a clockwork by means of an electro-magnet, thus causing a hammer to impress characters upon a surface. The application of this invention "to the electro-magnetic

telegraph" described in the specification of patent No. 8345, is set forth. "Two independent movements" are employed; one to bring "any required stamp to the proper position," (similar to the mechanism described in No. 8345, except that "steel punches," at the extremity of separate radiating springs, are substituted for the "paper disc"); another to move "the cylinder so that the type may be opposite to a fresh place," and to cause "the hammer to strike upon it when placed there." The detent has a piece of soft iron at its upper end, and is released from "the quickest wheel" "of the train" by the electro-magnet when the current passes, but has a "projection bearing against" a "slower wheel," that prevents the detent returning until its revolution. A "pin" is fixed on the slower wheel, which, by striking against a ratchet wheel and lever, puts in motion respectively the cylinder and the hammer to strike the punch. The cylinder may be moved helically by being rotated on an axis moving on a fixed screw; or a platform moved by a rack and pinion may be used. Alternate layers of white and blackened paper are employed to receive the impressions of the punch. 7th. Obtaining "any determined succession of independent and dissimilar actions," by means of a single electric circuit acting successively on electro-magnets through an inlaid disc. The application of this apparatus to telegraphic printing is set forth. By means of a spring rotating by clockwork over an ivory "disc," inlaid with metal pieces in connection with separate electro-magnets and mechanical movements, the clockwork is released, the type-wheel moved, the cylinder advanced, and the blow of the hammer struck; the spring then comes again to its first position; one end of the circuit wire is connected with the rotating spring, the other with the remaining ends of the wires of the electro-magnets. 8th. Recording the time at which distant actions take place. A surface carrying paper, ruled to represent equal intervals of time, is made to move uniformly by clockwork; and an electro-magnet, included in the circuit, has a lever armature carrying a pencil, which is depressed, and marks the paper whenever the circuit is completed.

A.D. 1841, August 21.—No. 9053.—De Moleyns, Frederick.—"Certain improvements in the production or development of electricity, and the application of electricity for the attainment of illumination and motion," relating to:—1st. A galvanic battery, composed of a mixture of a solution of nitrate of ammonia and sulphuric acid in contact with a "platina" plate, and muriate of ammonia in contact with an unamalgamated zinc plate; a sycamore porous cell divides the fluids. 2nd. A means of generating the electric light, by constantly supplying the electrodes at their junction with "pulverized charcoal" from a tube in which the upper electrode is enclosed. The electrodes consist of two coils of platinum wire of suitable thickness, the lower one enclosing a piece of spongy platinum. The whole arrangement is enclosed in an exhausted glass globe. 3rd. Constructing an electro-magnet, by rolling "a strip of sheet iron" with insulated wires laid upon it "upon a cylindrical rod," so that upon its withdrawal the sheet iron and wires may present "a compact electro-magnet, each wire having a surface of iron on both sides;" the hollow portion of the magnet may be filled up with an iron rod. An electro-magnet is described, consisting of "soft iron hollow cylinders," properly covered with insulated wires, introduced into one another, and fastened by "a screw." The above, or any other electro-magnets, are applied to electro-motion by fixing them on the rim and spokes of "a wooden wheel," "parallel to its axis;" similar electro-magnets are fixed so that their poles "are opposed" to the poles of those on the wheel; the motion of the wheel is produced by "a change in the polarities of the fixed magnets effected by a commutator worked by the wheel."

A.D. 1841, September 8.—No. 9077.—Barratt, Oglethorpe Wakelin.—"Certain improvements in the precipitation or deposition of metals," consisting of:—1st. The application of electric currents for the purpose of depositing copper and its alloys taken into solution in the acids employed during the process of cleaning such metals." "A saturated solution of copper" is made in dilute "dipping aquefortis." The work to be cleaned is placed in this solution in connection with the wire from the negative battery plate, and plates of copper are connected with the positive battery plate. If the articles to be cleaned are required bright, "free acid" is added; but if they are required dead, "muriatic acid" is added. 2nd. A mode of electro-depositing zinc "upon other metals." The articles to be coated are placed in a solution of zinc "in diluted sulphuric acid cold" in connection with the positive battery plate, a plate of zinc being attached to the negative battery plate. If amalgamated zinc is used in the battery, the zinc plates in the depositing liquid may be slightly amalgamated, otherwise they are not amalgamated. Other solutions of zinc may be used. 3rd. Two methods of electro-coppering iron and other metals. First, the articles to be coated are connected with a zinc plate wrapped in cloth, and the whole is immersed in an acid solution of sulphate of copper. Second, a solution of sulphate or "cyanuret" of copper is made in "cyanuret of potassium" by boiling. The articles are then immersed in this solution, proper battery connections being made with them and with copper plates in the solution. Other compounds of potassium or sodium may be used. If a brass surface is desired, zinc is electro-deposited on the copper surface, and a heat of 300° Fahrenheit is applied "in a muffle." 4th. Modes of depositing platinum from its solutions "as a covering to other metals." The article is connected to a zinc plate, and the whole immersed in an acid solution of platinum. Another process is to dissolve platinum in certain proportions of muriate of soda, alum, cream of tartar, and water; this solution may be used with or without the battery. Palladium may "be employed in like manner." 5th. Electro-depositing copper from mineral waters. A porous earthenware vessel is placed in a pit containing the cupreous solution and filled with a solution of muriate of soda. Iron is then placed in the porous vessel and connected with the sheets of metal intended to receive the deposit of copper. 6th. Gilding, silvering, or platinating. The metallic sulphuret is dissolved by boiling in hydrate of potash. These solutions may be used with or without a battery. 7th. Electro-depositing alloys of metals. The sulphurets of the metals forming the alloy, in the proportions requisite to make the alloy, are dissolved in "cyanuret of potassium." An "alloyed anode" of "the proportions contained in the solution" is employed "when using a galvanic or other battery."

A.D. 1841, December 9.—No. 9167.—Talbot, William Henry Fox.—"Improvements in coating or covering metals with other metals, and in colouring metallic surfaces," consisting of:—1st. "Adding gallic acid to the metallic solution intended to be precipitated." "A clean bright plate of metal" is immersed in "any convenient solution of silver, gold, or platina," to which an alcoholic solution of gallic acid has been added. 2nd. "A method of silvering metallic surfaces." "A clean bright plate of metal," is immersed in a solution of "freshly precipitated chloride of silver in hyposulphite of soda, or any other liquid hyposulphite." In either the 1st or 2nd process, a galvanic battery may be employed "to obtain thicker coats of metal;" "brass, copper, silver, German silver, and also (though less effectually) iron and steel" may thus be coated. 3rd. "Ornamenting surfaces of brass or copper, by first gilding them partially according to some pattern, and then washing them over with a solution of chloride of platina," which "gives a dead black appearance" to the parts not gilt. 4th. "A method of colouring polished surfaces of copper by exposing them to the vapour of sulphuretted hydrogen, or of any of the liquid hydro-sulphurets, or to the vapours of sulphur, iodine, bromine, or chlorine, or by dipping the metal into liquids containing them." Effective ornamental patterns may thus be produced, and "as it is easy to render the copper nearly white" by this method, it may be employed "for obtaining metallic specula or mirrors as follows:"—An electrotype cast from a polished surface is exposed "to the action of the vapours," "until it is sufficiently whitened;" the surface thus obtained is not liable to tarnish by exposure to the atmosphere.

How to Test Quicksilver and Detect Adulteration.—Quicksilver, after being extracted by the plain process of retorting, is seldom quite pure, and generally contains a small proportion of other metals. The eminent naturalist, Priestly, suggests a very simple method to purify mercury, by merely shaking it strongly in an iron flask, and renewing the air in the same repeatedly with a pair of bellows. By this manipulation a black powder will be formed on the surface, which can easily be separated. If no more of this dust is formed the quicksilver may be considered pure. In this state it will always give a clear sound when agitated in the flask, while an admixture of lead will make it sound dull, as if the vessel were made of potter's clay. It is often found in the market wilfully adulterated with lead, tin, and bismuth. Of lead, it can absorb or dissolve almost one-half of its weight, without losing much of its liquidity. This adulteration can easily be discovered by rubbing some of the metal on the open palm; if it soils the skin it is adulterated—if pure, it leaves no trace. Besides, if dosed with lead, it will leave a tail behind—*il fait la queue*, to use a French expression—that is, the drops, instead of being globular, will assume an elongated form, and a more or less flattened surface. Some of these observations may be, perhaps, useful to the electrician, as many complaints have latterly been heard about the impurity of the quicksilver sold for batteries, which fact is also proved by the frequent occurrence and admixture of base metal in the amalgam gold, probably in most cases by artificial means.

TELEGRAPHIC NEWS.

MAGNETIC TELEGRAPH COMPANY.—During the alterations now being made in the building, 58, Threadneedle-street, the offices of the secretary and superintendent of the above company will be at No. 54, Hercules-passage, Old Broad-street, E.C.

THE TELEGRAPH TO AMERICA.—At the general court of the Governor and Company of Adventurers of England trading into Hudson's Bay, held on the 28th ultimo, the chairman, Sir Edmund Head, observed with respect to the proposed line of telegraph through the Hudson's Bay territory—"The committee, as stated in the latter part of the report, had dispatched Dr. Rae out with an assistant, although the country between Red River and the Rocky Mountains was well known. The object was to examine and report on the best line for crossing the territory, and traversing the Rocky Mountains between Fort Edmonton and the head waters of the river Frazer. Dr. Rae's report might be expected at any moment." In reply to various questions put by shareholders, the chairman said—"The Board had offered to the Government to make a telegraph from the Red River to the Pacific, but they had not offered to make a thousand miles of railway for the benefit of Canada without being paid for it. Telegraphic communication was at present almost all in the hands of the United States."

THE OVERLAND TELEGRAPH THROUGH THE HUDSON'S BAY TERRITORY.—We see by a Vancouver paper that a letter has been received in that city from Dr. Rae, dated Fort Alexandria. The gallant explorer was then on the point of resuming his journey westward. He says:—"I came across by the Leather Pass to Tête Jaune Cache, sent my assistant back with three of the men and fourteen of the horses, bought two small Indian canoes, and not being able to get a guide, came down with three men, and ran all the rapids safely; and from Fort George sent back the Red River men, for whom five horses were left at the Tête Jaune Cache, to take them on to Edmonton, and I came on to this place in a small canoe with one man. My opinion of the route is very favourable for a telegraph. The difficulties will be falling timbers and fires, both of which may to a great extent be guarded against. I start shortly with the view of finding a nearer road to the Tête Jaune, and hope to get much information from Judge Begbie, at William's Creek."

DESTRUCTIVE FIRE AT A TELEGRAPH CABLE MANUFACTORY.—On Sunday evening the 27th ultimo, about eight o'clock, a fire broke out at the works of Messrs. J. & E. Wright, rope and patent submarine electric telegraph cable manufacturers, situate in Glenelg-road, West Ferry-road, Millwall. The premises were of great extent, and covered a large area of ground, some of the buildings being filled with intricate and costly machinery for the manufacture of rope. At the time before stated the private watchman had his attention drawn to a strong glare in one of the store-rooms, and on closer examination he found the place to be on fire. Owing to a large portion of the stock consisting of hemp and flax, the fire extended rapidly, the several store-rooms soon being in flames. It then spread to the offices and manufactory, and also to a large store of pitch and tar, in all about 500 barrels. The Millwall Volunteer Fire Brigade, with Mr. Roberts, their chief, promptly attended, and exerted themselves very creditably, but the flames, fanned by the wind, took possession of the rope-ground, which is of considerable length, and about 280 feet of it was destroyed. The fire also extended to the engine-house, and burnt the roof off, and also the roof of the tarring-house. By this time the London Brigade had arrived, and succeeded in extinguishing the flames. Although a large part of the property is consumed, yet a very considerable portion of the works has escaped destruction, so that the business of the firm will not suffer. The extent of damage is estimated at £10,000. The property is insured in the Royal, Commercial, and other offices.

NEW ZEALAND TELEGRAPHS.—Steps are now being taken by the general Government to lay down the electric telegraph from Auckland to Dunedin, a distance of about 1,000 miles; although possibly the native war may interfere for some time with its construction in the Northern Island; that portion running through the South Island, from Nelson viâ Picton, Christchurch, &c., to Dunedin, will, it is hoped, be in active operation within a few months, contracts for poles, &c., having been already accepted. Whether the rocky deep bed of Cook's Straits will be suitable for a submarine cable remains to be tested by survey and experiment. The distance from shore to shore is not very great, being in one place less than 25 miles. It will doubtless be some time before this portion of the work will be undertaken. The Morse instrument will be used. The work of connecting Invercargill with Dunedin by means of the electric telegraph is so far advanced that messages may be expected to be transmitted in the course of a few weeks. Nearly the whole of the posts are fixed, and the chief work to be done is to suspend the wires. What the effect of this interprovincial telegraph will be upon the future of Southland is a very tempting subject for speculation. It will certainly lend vast additional importance to Bluff's Harbour, which must, under any circumstances, be the telegraphic terminus of New Zealand. On the opening of this line both Otago and Canterbury will get their first English and intercolonial news viâ Invercargill.

OVERLAND ROUTE TO BRITISH COLUMBIA.—Dr. Rae was at the dinner of the Victoria Agricultural and Horticultural Society on the 29th September, and stated in his speech that the telegraph would be completed in about two years. The distance from Red River to Tête Jaune Cache was 1,200 miles, and by cutting a line through to William's Creek, instead of following the course of the Frazer river, the distance from that point to Victoria would be some 600 miles. He had studied the question of an overland route when the "bogus" company was established in London to carry passengers across, and he was firmly convinced that letters could be carried by it from England to Victoria in six or seven weeks, which he believed was about the present mail time. He had selected the Tête Jaune Pass as the most practicable route through the Rocky Mountains for several reasons—viz., because it was opposite the Saskatchewan river, the great inland highway, flowing through vast fertile plains; because there was abundance of fine land along the route, which would raise fine crops of wheat and barley; and because there was no land to clear. At Edmonton, 300 miles from Tête Jaune, he had seen 1,000 bushels of fine wheat grown, and a gentleman who had resided and farmed there for ten years told him that only twice in all that time had the crops failed from frost. There was no difficulty whatever in laying the telegraph line, except from bush and prairie, and these might be easily prevented by the usual precautions.

MISCELLANEA.

HOW THE WEATHER IS PREDICTED IN AMERICA.—Professor Henry at the Scientific Association, gave an account of the method pursued each day at the Smithsonian Institute. They have a map of the United States hung on a board, with pins stuck through at the points where the observers of the Institute are stationed. The Institute has daily reports by telegraph from many of these points. Each morning an assistant hangs a coloured cord on the pins to indicate the state of the weather—black if rainy, green if snowing, brown if cloudy, and white if fair. All storms travel east, and thus they are enabled to predict with great certainty the condition of the weather twelve hours in advance.

THE ROYAL SOCIETY.—The annual meeting of the members of the Royal Society was held on the 30th November at their rooms, Burlington House, Piccadilly. The chair was taken by the President, General Edward Sabine, R.A., D.C.L., who delivered a lengthened adress, in which he adverted to the leading scientific and geographical discoveries of the past year, paying in passing a graceful compliment to the memory of the late Captain Speke, the discoverer of the source of the Nile. At the close of the address, Dr. W. A. Miller was elected treasurer for the ensuing year, and Dr. William Sharpey and Mr. George Gabriel Stokes, M.A., secretaries. A council was elected, comprising the Earl Stanhope, Dr. Thomas Watson, Professor Wheatstone, D.C.L., Colonel Sir George Everest, C.B., Dr. James Alderson, Professor James Clerk Maxwell, M.A., Professor William Pole, C.E., the Rev. Professor Robert Willes, M.A., Mr. Geo. Busk, Dr. J. D. Hooker, Professor Henry J. Stephen Smith, M.A., Dr. Henry Bence Jones, Professor Sylvester, M.A., and other gentlemen. The Royal and Copley medals were presented by the President to the gentlemen to whom they had been adjudged. The anniversary dinner was held at Willis's Rooms in the evening.

ALUMINIUM BRONZE.—The French Society for the Encouragement of National Industry has awarded its highest testimonial, a gold medal, to Messrs. Deville and Debray, for their method of preparing aluminium bronze. Its composition is nine-tenths copper and one-tenth aluminium. It is homogeneous, and can be forged, and is second only to iron in tenacity. It is lighter than common bronze or brass—the aluminium, though but a tenth of the weight being a quarter of the volume. It has a fine grain, and wears so long that its use for journal boxes has already become more economical than common bronze, and it is not liable to cut the journals. It is not sensibly changed by air or even by weak acids, and retains its colour and brightness so well that it is deemed likely to be much used for carriage and saddle trimmings, and for cooking vessels, and even for table use instead of silver. Some trials indicate that it may also prove superior to common bronze for the manufacture of philosophical instruments. It is said to be impossible to separate the two metals when combined in these proportions.

ORNAMENTAL USES OF MICA.—The application of mica to ornamental purposes is extensively practised in Paris. When thus employed it is first cut to the desired thickness, then coated with a thin layer of fresh isinglass diluted in water, and the gold or other surface applied, after which it is allowed to dry. The sheet of mica can be easily rendered adherent to almost any article by glueing. The artisan then takes a pattern of copper, with a design cut on it, and places it on the reverse side of the mica, and with a small brush removes any superfluous parts; the required design thus remaining on the parts which have not been brushed. He then applies the colours either one or more times as may be necessary, and afterwards coats the whole with a solution of liquid glue diluted in spirits of wine, which is applied for the purpose of rendering the mica pliable. When this is effected, the mica with the design upon it is applied to the frame of the other object and fastened with glue. The junction of several pieces of mica is made imperceptible by first glueing them together with Venetian glue, and then applying a hot iron to the parts where the mica is joined together, the parts being thus completely united. From its unalterable nature, mica preserves the gilding, silvering, or colouring from deterioration, and from its diaphenity the articles so treated will preserve all their brilliancy. They are further preserved in a state of perfect cleanliness, as anything that soils them may at once be removed by washing. Mica is extensively used in the manufacture of tablet indicators for domestic and commercial telegraphs, so successfully employed by Bréguet, Grenet, and others in France and elsewhere.

Lenoir's Engine.—After laying for some time in abeyance, the development of M. Lenoir's invention in this country has been undertaken, it is said, and will be energetically carried on by the Reading Ironworks Company, who propose to construct the machine in four sizes, from ½-horse to 3-horse power, the price of which will vary from £55 to £125, and these amounts include the electrical apparatus connected with the machine. An annual royalty of £2 2s. to £3 3s. is charged for the use of the machine during the continuance of the patent.

Manufacture of Chlorine.—Many means have been employed for the manufacture of chlorine, including the application of the bichloride of copper and other bichlorides, but hitherto without success. Mr. de Tregomain has patented an invention which relates to improvements in the manufacture of chlorine by means of bichlorides, and also to the method of revivifying the latter. After the bichloride, which is heated to a deep red, has disengaged about half its chlorine, and has changed to a state of protochloride, he collects it, while in a state of fusion, and pours it on marble slabs, and then grinds it in a mill. The powder he obtains is introduced into a revivifying apparatus, in which he passes a current of air of sufficient amount, when the protochloride in powder, in coming in contact with the oxygen of the air, becomes changed into oxychloride or mixture of binoxide and bichloride of copper. In order to effect the revivification, he places the powdered oxychloride in stoneware vessels, containing hydrochloric acid at 23° Beaume, in the proportion of about 1 cwt. of dry oxychloride to 100 lbs. of acid. The matters are then heated, cooled, and crystallized, and the mother water drawn off, the crystals being dried and distilled over again.

Strange, if True.—A correspondent of the *Morning Star*, writing from Edinburgh on the 25th ultimo, says, "Yesterday, taking up one of the local newspapers for the purpose of perusing the telegraphic summary of Mr. Cobden's speech at Rochdale, I was immediately launched upon a sea of bewilderment. As I read the sense was continually tumbling over precipices and getting lost. Every now and then a sentence performed the feat of jumping down its own throat. Here an idea would duck under like a sea bird, and appear again in the most unexpected place, and in the strangest company. In the most mysterious manner one thing melted into another like the scenes in dissolving views. What could it mean? Was Mr. Cobden mad or was I? Was Mr. Cobden drunk when he spoke? Was I drunk when I read? Was the telegraph drunk when it reported? There was a strong spirit of lunacy in the matter without question, and turning to an editorial note the mystery was solved at last. The editor lacking time and patience to comb and dress the dishevelled telegraphic summary into sense and coherence, and wishing also to let the public know in what sort of way the work is done at the telegraph office here, had printed the communication as it had arrived, inexplicable punctuation and all." The correspondent of the *Star* enquires whether Mr. Cobden, himself, or the telegraph, was under "the influence?" From the foregoing statement we incline to the opinion that the telegram was received by the editor in question in proper order, that by some means the pages became transposed in the hands of the gentleman of the press who found himself "incapable" of combing and dressing, or giving coherence to anything. The explanatory (?) foot-note referred to must have been added by some commisserating subordinate in the newspaper office—the "devil" mayhap.

PATENTS.

APPLICATION FOR LETTERS PATENT.

2950. T. Knowles, improvements in switches or points for railways.
2935. R. Wheble, improvements in the means of and apparatus for communicating between passengers, guards, and drivers of railway trains.
2941. P. E. Gaiffe and E. Zolinicki, an engraving apparatus, called "Electro-graphique."

NOTICES TO PROCEED.

1840. P. Le Boulengé, an electro-balistic chronographe.
1906. E. Tattersall, improvements in effecting communications in railways between passengers and guard.
2486. C. H. Collette, improvements in magneto-electric machines.—A communication.

NOTICE OF APPLICATION FOR THE CONFIRMATION OF A PATENT.

2800. W. A. Shepard, for improvements in preparing and treating gutta-percha and india-rubber.

PATENTS ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF THEIR PRODUCTION FOR CERTIFICATE.

3015. E. Tyer, improvements in electric telegraphs.—November 29th, 1861.
2997. H. Wilde, improvements in magneto-electric telegraphs and in apparatus connected therewith.—November 28th, 1861.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2607. A. Reynolds, improved mode of manufacturing sulphuric acid.
2675. A. Parkes, improvements in manufacturing compounds of gun cotton, and other vegetable substances similarly prepared, also in the preparation of castor and cotton oils and gum ballata, to be used with or separate from such com[illegible]ds.
2813. E. Richardson, improvements in means and apparatus for producing or effecting fog-signals.
2857. R. Holiday, improvements in the mode of locking or securing the levers used to work railway signals and points.

PATENT SEALED.

1405. W. H. Preece, improved domestic telegraphic apparatus.

PATENTS WHICH HAVE BECOME VOID.

2850. W. Clark, the application of electricity in refining cast-iron for the purpose of converting it into wrought-iron or steel, with or without the addition of other agents.—A communication.
2866. J. Macintosh, an improvement in preparing telegraphic wire which is coated with gutta-percha, in order to render it more capable of resisting heat, and in laying down telegraph wires in the sea.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	1/9 to 2/	per lb.

India Rubber.

Para, first quality	1/7 to 1/8	"
second "	1/4 to 1/5	"
third Negro-head	1/1 to 1/2	"
Java and Penang	1/2 to 1/4	"

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	57 to 62	—
Stock	Electric Telegraph . . .	100	106 to 110	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$\frac{3}{4}$ to $\frac{1}{4}$ dis.	—

TO CORRESPONDENTS.

J. H. S.—We will send you the information required per post.

G. Whyte.—The cores of soft iron are wound with half a mile of silk-covered wire.

Henry Eglinton.—The best synchronous printing telegraph now in use is Hughes's, which is employed with great success on several lines in France.

A Subscriber.—Messrs. Rose & Co., of 66, Upper Thames-street, supply the article at £31 per ton.

Telegrapher.—Professor Daniell discovered the constant battery which bears his name in the year 1837.

Edward Butler.—Besides Culley's "Handbook of Practical Telegraphy," we can recommend Mr. Prescott's "History of the Electric Telegraph."

W. E.—Harrison Gray Dyar erected an experimental line of telegraph at Long Island, U. S., in 1827 or 1828. On this line he employed frictional electricity to make a mark on paper prepared with saline solutions.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. Smith & Co., Strand; J. Onwhyn, Catherine-street, Strand; Messrs. Dawson & Co., Cannon-street E.C.; Messrs. Kent & Co., Paternoster-row, London. Messrs. Heywood & Co. Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

The *Telegraphic Journal* is the most effective medium for inventors, patentees, contractors, manufacturers of insulating materials and electric apparatus to submit their various specialities to the consideration of secretaries and managers of telegraph or railway companies, and other persons engaged in electrical and telegraphic pursuits.

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ON RAILWAY ELECTRIC SIGNALLING.

BY W. H. PREECE, ASSOC. INST. C.E.

(*Continued from page* 267.)

Now the last, and, perhaps, the most important, requirement demanded of us is, that any derangement of the apparatus, or the accidental delivery of a false signal, either by the man himself or by the mechanical interruptions to which the wires are liable, shall at once indicate danger and produce safety. I have previously observed that it is impossible to make the "all clear" signal at one station without the consent and action of the man at the other station; and, moreover, I have shown that this signal cannot be complete until it has been acknowledged by the man at the distant station, and not then unless the instruments have acted correctly. It therefore follows that the derangement of the apparatus, or the accidental delivery of a false signal, at once attracts attention, and indicates danger.

The accidents to which electric signals are liable require some consideration. They are numerous, and depend upon several natural and artificial causes.

It will be observed in carrying out this system of signalling, that a distinct and separate wire is employed for each operation. Each action is performed totally independent of the other. The advantages of this are numerous. Each instrument having its distinct duty to be performed, should anything break or become disordered it can be easily replaced without disarranging or removing the whole apparatus. When any defect or accident, such as the breaking of a spring or the loosening of a screw, occurs, its position or cause is at once evident, and within the power of any intelligent signalman to rectify. If either wire or any part of the apparatus is placed *hors de combat*, temporary communication and protection can be maintained by some preconcerted system upon the other wires. Should the bell-wire fail, attention can be obtained and communication conducted by means of the semaphores. Should one or both semaphores fail, signalling can be temporarily carried on by means of the bell-wire. The use of three wires also enables us to accomplish that perfect system of repetition which is so conducive to safety and productive of confidence, and to maintain that permanent system of signalling which signifies to us at once any failure in the mechanism or accident to the wire. Where a single line exists, it is only necessary to have two wires—one for the bell circuit and one for the line; and the signalling can be conducted as effectively as for two lines with three wires.

Now, it is perfectly practicable to conduct a system of signalling upon the principles I have enunciated with one wire —and it is so done on the Charing Cross Extension of the South Eastern Company—but the adoption of one wire not only necessitates the abandonment of the complete check afforded by the repeating system, but it renders the system liable to all the dangers arising from a flood of accidental and natural causes.

When three wires are employed, the all clear signal is maintained by a constant and permanent flow of electricity—the result is, that if this current be interrupted or stopped by any cause, the arm will at once fly up, and the danger signal be exhibited. When one wire only is employed, the necessary signals are produced by momentary currents of electricity, and the permanence of the signal is maintained by local magnetism or gravity—the result is, that no derangement of the apparatus or wire is reported, and the instrument may continue to show safety when danger really exists.

The use of momentary currents necessarily leaves what is termed an open circuit, and leaves the instruments peculiarly liable to all the disturbances of atmospheric electricity. A flash of lightning might directly enter the wire, and derange both instruments, but when three wires and permanent currents are employed, the lightning would at once be conducted quietly to the earth without passing through the semaphore. But the most dangerous action of atmospheric electricity is the inductive action of a cloud charged with electricity, which might be passing even at the distance of several miles. This inductive effect invariably takes the form of a momentary current, as though it emanated from a powerful battery. It is singularly destructive to the correct working of the needles of the ordinary speaking telegraph. It sometimes completely demagnetizes the needles, and at other times reverses their magnetism so that they give totally opposite indications to that which they are intended to record. It is for this reason that I consider the ordinary needles inadmissible into railway signals, because a flash of lightning may make them say "line clear," when they should say "line blocked:" they indicate safety when there may be danger. Now, with three wires and persistent currents such inductive effects are harmless, but with single wires and momentary currents they are dangerous: they might give false signals. The arm might be lowered when it should continue raised, and the absence of any repeater or check would endanger the line.

Another natural phenomenon—that commonly termed "deflections" or "earth currents"—seriously affects circuits worked by momentary currents. At certain times and seasons immense masses of electricity pass through the crust of the earth, traversing the telegraph circuits in their course, and causing great annoyance and trouble to the speaking telegraphs. In instruments worked by permanent currents they can never produce any effect, because on short circuits they never equal in force the ordinary working currents; but instruments worked by momentary currents require to be much more delicately set, and therefore are liable to be actuated by earth currents, producing thereby false signals and consequent danger.

There are also interruptions arising from accidental and artificial causes. The wires may be brought into temporary contact by the wind, or, as they frequently are, by the long levers of the platelayers. Cases have been known where birds alighting upon the wires have produced similar effects. The wires may simply touch each other for an instant, but it would be quite sufficient to draw a current from one wire, and produce what is called a *contact*. These occasional contacts—"intermittent," as they are technically called—produce false signals on instruments worked by momentary currents, while those actuated by continuous currents would remain unharmed.*

* An accident which occurred on the London, Brighton, and South Coast Railway, near the Victoria Station, on October 16th, 1860, was undoubtedly due to this cause. Captain Tyler said, in his Report to the Board of Trade:—"There is no question in this case of any irregularity in the working of the instruments, or of the needle having been pushed over accidentally at the Victoria Junction, because the statements of Bucknell and Agent are to the effect that they both saw the needle go over, and both heard the bell ring at the same time, though they could not be sure as to whether it rang three times or not."

The use of momentary currents also necessitates the use of two keys or buttons to send the opposite currents instead of reversing them in the instrument itself, so that the signalman has sometimes to push one button and sometimes the other; and in some systems he has to do this to make the same signal. The same key that rings the bell makes the signal. This is a serious defect, as in the hurry of the moment the signalman may press the wrong key—an accident that has frequently occurred.

But a contact may be "full" or continuous. The wires may be blown together; a wire may be broken by frost, rust, or force, and fall over the others; an insulator or its binding may break; and drop one wire on to another; workmen may accidentally twist the wires together; poles, signal-posts, trees, &c., may be blown down by the wind, and bring all the wires together; wires may be wilfully twisted by evil-disposed persons; a train may run off the line, and knock down posts and wires; and numerous other causes may bring the wires together. Now, it is essential when such accidents occur that either the instruments be unaffected, or else that they at once give evidence of the accident, or exhibit the danger-signal, and thereby secure safety. Instruments worked by momentary currents upon one wire under such circumstances give false signals, and indicate false security; but those worked by permanent currents at once show danger. Whatever happens to the wire, whether it be broken or in contact with another wire, or touching the earth, will at once cause the semaphore or disc to indicate the danger signal, and secure safety. It is not so with instruments worked by momentary currents, and therefore I contend that systems based upon such a principle, and dependent upon one wire and momentary currents for their action, are fundamentally wrong and dangerous in practice. What is wrong in principle cannot be right in practice, and though we have not yet had any serious disaster from the failure of one of these single-wire signalling systems, the day must come when experience will show their utter incapacity and complete insufficiency to secure absolute safety.

There are several arguments adduced against the use of three wires and persistent currents. The first is their cost and annual maintenance expenditure; but who would weigh the comparative cost where absolute security is attained as against probable danger? And what is the difference in cost? About £15 per mile, and £1 per mile per annum! for three wires as against one. Again, it is urged that batteries get weaker and weaker when employed for persistent currents, until failure of signals takes place. Undoubtedly; so does a lamp burn out if not replenished with oil; so will a fire go out if not fed with coal; but while the duration of a fire can be counted in minutes, that of a lamp in hours, a battery remains in action for months. A battery requires occasional attention to maintain it in order, as does every other convenience where materials are consumed and power generated. But any diminution in the strength of the battery is immediately exhibited on the semaphore by the sluggishness with which the arm falls to "all clear." Men are detailed especially for this duty, and whenever the action of the semaphore becomes sluggish their attention is at once called to it by the signalman. It is also stated that in the event of a wire fracturing it would foul the others, and by thus dividing the current record a false signal. This objection may be true for needle instruments, but it cannot apply to the semaphores, for such an occurrence has the instant effect of raising the danger signal and securing safety, as I have previously explained.

I have now completed the discussion of the various points desiderated as necessary for the security of a system of railway electric signalling. I have shown how a perfect means of communication can be established between two stations for the announcement of the approach and departure of trains; how an unmistakeable and unalterable "danger" and "all clear" signal can be established at a distant station; how this can be effected with absolute security and perfect confidence, and how every accident, either of carelessness, absence, or accident, can only provoke security and avoid accident. Moreover, I do not theorise, but explain what is fully carried out in practice, and what is easily observable by anyone who chooses to examine the system at work. It now only remains for me to explain the practical working of the system, and the different localities of a line where electric signalling is serviceable.

Having described the various parts of the apparatus and their connexion as a whole, it now remains for me to explain the various railway purposes to which it is applicable. And, first, as regards the

BLOCK SYSTEM.

It is scarcely necessary to enlarge upon this particular point, because it has been borne in view and discussed throughout the preceding pages. The instructions which are given to signalmen who work this system of signalling are as follows:—

1. No train or engine is to be allowed to pass your box unless the electric signal for the section into which it is about to proceed stands at ALL CLEAR.

2. When a train has entered the section of line which you have protected (under Rule 4), you will signal to the next station, two beats on the bell *twice*, to signify "Train coming; be ready."

3. On the approach or arrival of the train or engine at your box, you will, provided the electric signal stands at ALL CLEAR, at once signal it on the bell to the next station in advance, thus:—

If a passenger train .. by 2 beats.
" goods train ...... " 3 "
" special or engine . " 4 "

4. This signal will be acknowledged by the corresponding station, by throwing his switch-handle over to "ON," thereby placing the electric signal at your station at DANGER, and protecting the line from any train following that already in the section.

5. You will acknowledge this signal by returning one beat of the bell.

6. On the arrival of the $\left\{\begin{matrix}\text{Down}\\ \text{Up}\end{matrix}\right\}$ train at $\left\{\begin{matrix}\text{A}\\ \ \end{matrix}\right\}$, the signalman at that station will pull his switch-handle over to OFF, thereby removing your danger signal, intimating the arrival of the train and clearing the line.

7. This you will acknowledge by one beat on the bell.

8. In case any obstruction exists upon the line to necessitate its being blocked, give five sharp beats on the bell (which must be repeated), and raise the electric signal to *Danger*, which must be maintained as long as the obstruction lasts.

9. No signal is to be considered complete until it has been acknowledged.

1. The first rule is very widely departed from on most lines which adopt electric signalling. On the London and North Western Railway any engine or train arriving before the line has been cleared is *ordered* to be stopped, and the driver and guard told by the policeman on duty that the line is blocked, according to the instruction of the instrument. It is then allowed to proceed with caution. Two, three, and sometimes even four trains, are allowed to be on the same section of line at the same time. The system of signalling thus becomes simply a medium of warning and caution, and by no means an element of safety from collision, as the Reports of the Government Inspectors to the Board of Trade abundantly prove.

The Great Northern Railway adopt a somewhat similar plan, and until recently the London and Brighton Railway Company did the same; but three successive accidents in one month, all arising from the absence or neglect of the pure block system upon their main line, altered their preconceived opinions, and showed them the necessity of the block system. There can be no absolute safety unless the block be made absolute. If the distance between the signalling stations be too great to carry it out without excessive delay, they should be brought nearer together. If they cannot be brought nearer, then there is a decided necessity of a third set of rails.

2. It is found extremely convenient in practice to know that a train is approaching. The warning signal is produced by giving two beats succeeding each other after a slight interval, to distinguish the first two from the second two, and not

confuse it with No. 4 signal on the bell code. It enables a station master to cease all shunting; it calls the attention of the signalmen to their signals and points; it compels them to attend to their duties, and it prevents, what is one of the great advantages of the block system, the unnecessary exhibition of the danger signal.

3. When the train is a fast passing train, it is signalled on its approach; if a stopping train, on its arrival; or if the signal boxes be very near to each other, trains can invariably be signalled on their approach. These are matters of detail which cannot well be embodied in general instructions, and are generally given verbally or in writing, according to the peculiarities of the locality and traffic.

I have previously shown how this code can be varied to suit the different requirements of the line upon which the system is established, and how the down are distinguished from the up trains. This signal, "train in," is not given unless the signal shows "all clear," because the previous signal, No. 2, has warned the further station of the approach of a train, and he would have cleared the line if it were clear. If it is maintained an unnecessary time, it is usual to inquire the reason on the speaking telegraph, if such a telegraph exist; but if there should be no telegraph, a signal is used on the bell to express impatience, or to inquire why the signal is maintained. (No. 7 Bell Code.) If the signal is still to be maintained, the obstruction signal (5) would be given. If the signal cannot be lowered, nor the all clear signal given on the bell, from any accident to the wires or apparatus, then the train would proceed under the General Regulations. The "all clear" signal on the bell is given by three beats, given twice and repeated. This is not introduced into the instructions, because it is only used when the semaphores break down. A code of instructions for the bell is sometimes made, for the special service of the different sections and branches of a line.

4. We thus see that by (2), the approach of a train is announced, and by (3), its actual departure notified. The signalman who receives these signals, and who has the protection of the section of line over which the train is running, under his charge, by Rule 4, raises the danger signal at the station which the train has just left, to protect the line from any following train. The out-door signals always follow the electric, and are similarly placed at danger. This signal is maintained until the train has passed clear of that section.

5. The danger signal is acknowledged and repeated in such a manner that no mistake is possible. The means of accomplishing this have been so fully detailed that no more need be said about it. Its use is too evident to need remark.

6. The danger signal is maintained until the train arrives at the station towards which it is proceeding. Now the question is this,—should the signal be lowered when the train has arrived within the protection of the distant signals? when it is protected by the station standard or fixed signal? or when it has left the station? Upon the plea of security, the latter plan is undoubtedly the safest; upon the score of delay, the first is the most advantageous; but this rule must be made to suit the particular traffic of the line upon which the system is worked. I consider that every station should be supplied with a "stop" signal, independent of the station standard signal, whose indications refer to the line beyond the station, and whose signals are governed by, and should exactly correspond with, the electric signals. This signal would therefore be practically a distant signal wrought from the other station. Every train would come within the protection of the station signals, and would wait at this signal to receive instructions to proceed. Such a signal is, however, rarely used, and the necessary instructions to proceed are given by flag or hand.

I would never clear the line until the train, if a stopping train, is well under the protection of the station signals; and, if a passing train, until it has completely passed the signal box—a practice which, though general, is by no means universal. On the London and North Western line it is ruled that when the signalman observes from the appearance of the passing train that it is going slowly, or likely to fail, the block must be maintained until time has been allowed for the slow train to make some progress over the next section.

The signalman may also observe something wrong with the train,—the tail lamps off, coupling-chains unhooked, tyres loose, a carriage on fire, excited passengers unable to attract attention, &c. He would then give the attention signal (No. 7 Bell Code), and maintain the block until he was satisfied that the line was clear, or until he had ascertained through the station master, by means of the telegraph, that all was right.

There are certain large stations where shunting is always going on, and where the fixed signals are nearly always at danger. It would be impossible in such cases to adhere strictly to these rules without incurring excessive delay. Now, such stations should invariably be protected at their two extremities with signalling boxes and fixed signals, and that as soon as a train comes within the protection of these signals the line should be cleared. The points, crossings, and shunting operations, between the two boxes would all be regulated by hand and station signals. The electric signals would only protect the line beyond the electric signal boxes. Delays are thus avoided. Trains can run up to the signal boxes at the extremities of the station, while in the meantime, from the warning that has been given of the approach of the train, the station yard can be cleared, and the train admitted or passed on on its proper rails.

7. The clearing of the line is also acknowledged and faithfully reported on the repeater.

8. When any obstruction exists upon the line beyond the protection of the fixed signals, from an accident to the train or other cause, this signal is given; and when any shunting occurs which cannot be fully protected by the fixed signals it is also used. It is a very useful signal, and is always accompanied by the raising of the danger signal. When this signal is received, the out-door signals are immediately raised to danger, and nothing is allowed to pass until the line is cleared.

These rules, if fully carried out, cannot fail to ensure safety from collision; and they are believed, if rigidly obeyed, to be sufficient to carry out the block system in its entirety.

The Government Inspectors invariably recommend that a speaking telegraph should accompany every electric signalling system, to fall back upon in cases of failure, misconception, or confusion. The necessity of a telegraph is therefore based upon the assumption of the fallibility of the signalling apparatus. But my experience proves that ordinary telegraphs are far more liable to disorder than signalling apparatus; and to erect an uncertain agent for the protection of a comparatively certain one is unsound philosophy. Moreover, the presence of a telegraph tends to reduce the attention of the signalman from his own instrument. When he knows that he has a telegraph to fall back upon, he is not so likely to regard the maintenance and true working of his own apparatus. The Bell Code is constructed to meet every possible emergency that may arise in the ordinary operations of signalling; and if anything unusual or extraordinary should occur, he has but to consult the station master, who has the control of the general telegraph, without which no line should be worked.

In all the annals of railway accidents which I have examined, I can only find one instance* where a speaking telegraph would have been serviceable in rectifying a mistake and avoiding an accident, and this arose from an inefficient system; but the records of accidents arising from the failure or misconception

* *Vide* Capt. Tyler "on a collision at the Commercial Dock Station of the South Eastern Railway Company, Dec. 15th, 1860." Reports, 1861, p. 130.

of the electric telegraph are too numerous to require recapitulation. I need only refer to the lamentable accident at Clayton Tunnel, on the Brighton Railway, to instance the danger of depending upon a speaking telegraph in moments of confusion.

The Government Inspectors also require the careful entry in proper Record Books of the times of signalling and passing of all trains. This is doubtless a very effective check upon the proper discharge of his duties by the signalman, and a most valuable witness in his favour, when properly maintained, in all cases of accident. Captain Tyler says,* "A man is obviously less likely to commit an irregularity of any sort in duties of this description when he is himself compelled to make a permanent record of it, liable at any time to be brought against him, open to observation on periodical or irregular inspections, and checked by other records made by responsible officers within a short distance, and perhaps on both sides of him." Record books should invariably accompany electric signalling. In the Appendix will be found the form of Record Book adopted on the South Western Railway.

(*To be continued.*)

* *Vide* [illegible] of Inspecting Officers, &c., 1861, p. 90.

PNEUMATIC DISPATCH AND TELEGRAPHY.

We extract the following from the *Manchester Examiner and Times* of the 6th instant:—

Yesterday the principle of pneumatic dispatch—propulsion by atmospheric pressure through a tube in which a vacuum has been created—was put to practical commercial use in this city, to facilitate telegraphic communication. Owing to the increase of their business in Manchester, the Electric and International Telegraph Company have lately taken extensive premises in York-street, and opened a central station there. In order to facilitate the rapid dispatch of messages from the branch offices at Ducie-buildings (Royal Exchange), and No. 1, Mosley-street, it has been deemed advisable to connect these offices with the central station by means of the pneumatic system, the same as is adopted by the company in London and Liverpool. Between the branch offices above-mentioned and the central station leaden pipes, with an inside diameter of $1\frac{1}{2}$ inches, have been laid down under the streets. The leaden pipes are made perfectly air-tight, and are enclosed in 2-inch iron pipes to protect them from being damaged. At the central station there is fixed in the basement a small high-pressure beam engine, and connected with it a double-action air pump, 17 inches in diameter and 15 inches stroke. This pump is continually at work exhausting the air from a cylinder 8 feet long and 4 feet in diameter, which is styled the vacuum cylinder. The pipes which pass under the streets from the branch offices are terminated in the instrument room on the top floor of the building, and the pipes from the vacuum cylinder are also carried to the same place, and they can be put in connection by simply opening a valve. The carriers which travel through the pipes are made of gutta-percha covered with felt. They are about 5 inches long, and of a diameter nearly equal to that of the pipe. They are hollow inside for the purpose of containing the messages. Electric bells are employed to give the necessary signals for the working of the pipes. When the officials at the Ducie-buildings office wish to send a "carrier," they place one in the mouth of the pipe, and signal the central station by ringing its bell. The clerk in attendance at the latter place, by moving a small lever, puts the pipe in communication with the vacuum cylinder. The air in the pipe then rushes into the vacuum cylinder, and the "carrier," having the ordinary atmospheric pressure behind it, is propelled through at a speed of from 35 to 40 miles an hour. On the arrival of the "carrier" at the central station it strikes against a spring buffer, which, by a simple, self-acting contrivance, cuts off the communication between the pipe and the vacuum cylinder, and the "carrier" falls from the valve on to a counter prepared to receive it. To send a "carrier" from the Mosley-street office, the action is precisely the same. By using a second chamber, and compressing air into it, a force is obtained for blowing the "carriers" from the central station to the branch branch offices, so that the pipes can be made available for carrying in both directions. The great advantage of this new system is, that it enables the Electric Telegraph Company to cope with the increasing traffic, to perform the service more expeditiously and more cheaply, and also to avoid the liability to make errors consequent upon the transmission between the branch and the central stations by the usual means of telegraphing. Mosley-street to central office, 325 yards. Ducie-buildings to central office, 501 yards. The branch office in Mosley-street is about 320 yards from the central office, and the distance of the Ducie-buildings branch office is 510 yards. The time occupied by a "carrier" in traversing the shorter distance is 22 seconds. Time in travelling from Ducie-buildings to central office, 30 seconds; from Mosley-street to central office, 10 seconds. This mode of transmitting messages has been in operation in London several years. The central office in Moorgate-street is connected by pipes with nearly a dozen of the principal branch offices in different parts of the city, which are thus placed in almost instantaneous communication with the instrument room. Thus, a message for any part of the country, or for the continent, may be in process of transmission to its destination before it could be received at the central office, when every word had to be sent by the wire. A popular explanation of the principle of pneumatic dispatch was recently given in an account of the experimental railway at the Crystal Palace. It will also be remembered that the principle has been applied by the General Post-office in the transmission of mails between Euston-square and St. Martin's-le-Grand. There can be little doubt but that when the simplicity of the system becomes known it will be extensively adopted. Meanwhile, the public are indebted to the Electric Telegraph Company for proving its utility, and availing themselves of it wherever the amount of their business will warrant its application.

ON THE ELEMENTARY RELATIONS BETWEEN ELECTRICAL MEASUREMENTS.*

BY PROFESSOR J. CLERK MAXWELL AND MR. FLEEMING JENKIN.

I.

1. *Objects of Treatise.*—The progress and extension of the electrical telegraph has made a practical knowledge of electric and magnetic phenomena necessary to a large number of persons who are more or less occupied in the construction and working of the lines, and interesting to many others who are unwilling to be ignorant of the use of the network of wires which surrounds them. The discoveries of Volta and Galvani, of Oersted, and of Faraday, are familiar in the mouths of all who talk of science, while the results of those discoveries are the foundation of branches of industry conducted by many who have perhaps never heard of those illustrious names. Between the student's mere knowledge of the history of discovery and the workman's practical familiarity with particular operations which can only be communicated to others by direct imitation, we are in want of a set of rules, or rather principles, by which the laws remembered in their abstract form can be applied to estimate the forces required to effect any given practical result.

We may be called on to construct electrical apparatus for a particular purpose. In order to know how many cells are required for the battery, and of what size they should be, we require to know the strength of current required, the electro-motive force of the cells, and the resistance of the circuit. If we know the results of previous scientific inquiry, and are acquainted with the method of adapting them to the case before us, we may discover the proper arrangement at once. If we are unable to make any estimate of what is required before constructing the apparatus, we may have to encounter numerous failures which might have been avoided if we had known how to make a proper use of existing data.

All exact knowledge is founded on the comparison of one quantity with another. In many experimental researches conducted by single individuals, the absolute values of those quantities are of no importance; but whenever many persons are to act together, it is necessary that they should have a common understanding of the measures to be employed. The object of the present treatise is to assist in attaining this common understanding as to electrical measurements.

2. *Derivation of Units from Fundamental Standards.*—Every distinct kind of quantity requires a standard of its own, and these standards might be chosen quite independently of each other, and

* This paper is appended to the report of the committee, appointed by the British Association, on Standards of Electrical Resistance.

in many cases have been so chosen; but it is possible to deduce all standards of quantity from the fundamental standards adopted for length, time, and mass; and it is of great scientific and practical importance to deduce them from these standards in a systematic manner. Thus it is easy to understand what a square foot is when we know what a linear foot is, or to find the number of cubic feet in a room from its length, breadth, and height; because the foot, the square foot, and the cubic foot are parts of the same system of units. But the pint, gallon, &c., form another set of measures of volume which has been formed without reference to the system based on length; and in order to reduce the one set of numbers to the other, we have to multiply by a troublesome fraction, difficult to remember, and therefore a fruitful source of error.

The varieties of weights and measures which formerly prevailed in this country, when different measures were adopted for different kinds of goods, may be taken as an example of the principle of unsystematized standards, while the modern French system, in which everything is derived from the elementary standards, exhibits the simplicity of the systematic arrangement.

In the opinion of the most practical and the most scientific men, a system in which every unit is derived from the primary units with decimal subdivisions is the best whenever it can be introduced. It is easily learnt; it renders calculation of all kinds simpler; it is more readily accepted by the world at large; and it bears the stamp of the authority, not of this or that legislator or man of science, but of nature.

The phenomena by which electricity is known to us are of a mechanical kind, and therefore they must be measured by mechanical units or standards. Our task is to explain how these units may be derived from the elementary ones; in other words, we shall endeavour to show how all electric phenomena may be measured in terms of time, mass, and space only, referring briefly in each case to a practical method of effecting the observation.

3. *Standard Mechanical Units.*—In this country the standard of length is one yard, but a foot is the unit popularly adopted. In France it is the ten millionth part of the distance from the pole to the equator, measured along the earth's surface, according to the calculations of Delambre, and this measure is called a metre, and is equal to 3·280899 feet, or 39·37079 inches.

The standard unit of time in all civilized countries is deduced from the time of rotation of the earth about its axis. The sidereal day, or the true period of rotation of the earth, can be ascertained with great exactness by the ordinary observations of astronomers; and the mean solar day can be deduced from this by our knowledge of the length of the year. The unit of time adopted in all physical researches is one second of mean solar time.

The standard unit of mass is in this country the avoirdupois pound, as we received it from our ancestors. The grain is one 7,000th of a pound. In the French system it is the gramme derived from the unit of length by the use of water at a standard temperature as a standard of density. One cubic centimetre of water is a gramme = 15·43235 grains = ·00220462 lbs.

A table, showing the relative value of the standard and derived units in the British and metrical system, is given in section 55

The unit of force adopted in this treatise is that force which will produce a unit of velocity in a free unit mass by acting on it during a unit of time. This unit of force is equal to the weight of the unit mass divided by g, where g is the accelerating force of gravity

$$\left.\begin{array}{l} = 32{\cdot}088\ (1 + 0{\cdot}005133 \sin^2 \lambda) \text{ in British units} \\ \text{or } = 9{\cdot}78024\ (1 + 0{\cdot}005133 \sin^2 \lambda) \text{ in metrical units} \end{array}\right\} \text{at the level of the sea,}$$

λ being the latitude of the place of observation. A unit of force still very generally adopted is the weight of the standard mass. The value of the new unit is $\frac{1}{g}$ times the old or gravitation unit.

The unit of work adopted in this treatise is the unit of force, defined as above, acting through the unit of space.

4. *Dimensions of Derived Units.*—Every measurement of which we have to speak involves as factors measurements of time, space, and mass only; but these measurements enter sometimes at one power, and sometimes at another. In passing from one set of fundamental units to another, and for other purposes, it is useful to know at what power each of these fundamental measurements enters into the derived measure.

Thus the value of a force is directly proportional to a length and a mass, but inversely proportional to the square of a time. This is expressed by saying that the *dimensions* of a force are $\frac{LM}{T^2}$; in other words, if we wish to pass from the English to the French system of measurements, the French unit of force will be to the English as $\frac{3{\cdot}28 \times 15{\cdot}43}{1}$: 1, or as 50·6 to 1; because there are 3·28 feet in a metre, and 15·43 grains in a gramme. If the minute were chosen as the unit of time, the unit of force would, in either system, be $\frac{1}{3600}$ of that founded on the second as unit.

A table of the dimensions of every unit adopted in the present treatise is given in section 55.

5. *Magnets and Magnetic Poles.*—Certain natural bodies, as the iron ore called loadstone, the earth itself, and pieces of steel after being subjected to certain treatment, are found to possess the following properties, and are called magnets.

If one of these bodies be free to turn in any direction, the presence of another will cause it to set itself in a position which is conveniently described or defined by reference to certain imaginary lines occupying a fixed position in the two bodies, and called their magnetic axes. One object of our magnetic measurements will be to determine the force which one magnet exerts upon another. It is found by experiment that the greatest manifestation of force exerted by one long thin magnet on another occurs very near the ends of the two bars, and that the two ends of any one long thin magnet possess opposite qualities. This peculiarity has caused the name of "poles" to be given to the ends of long magnets; and this conception of a magnet, as having two poles capable of exerting opposite forces joined by a bar exerting no force, is so much the most familiar that we shall not hesitate to employ it, especially as many of the properties of magnets may be correctly expressed in this way; but it must be borne in mind, in speaking of poles, that they do not really exist as points or centres of force at the ends of the bar, except in the case of long, infinitely thin, uniformly magnetized rods.

If we mark the poles of any two magnets which possess similar qualities, we find that the two marked poles repel each other, that two unmarked poles also repel each other; but that a marked and an unmarked pole attract each other. The pole which is repelled from the northern regions of the earth is called a positive pole; the other end the negative pole. The negative pole is generally marked N by British instrument-makers, and is sometimes called the north pole of the magnet, whereas it is obviously similar to the earth's south pole.

The strength of a pole is necessarily defined as proportional to the force it is capable of exerting on any other pole. Hence the force f exerted between two poles of the strengths m and m_1 must be proportional to the product $m\,m_1$. The force, f, is also found to be inversely proportional to the square of the distance, D, separating the poles, and to depend on no other quantity; hence we have, unless an absurd and useless coefficient be introduced,

$$f = \frac{m\,m_1}{D^2} \qquad (1)$$

From which equation it follows that the unit pole will be that which at unit distance repels another similar pole with unit force: f will be an attraction or a repulsion, according as the poles are of opposite or the same kinds. The dimensions of the unit magnetic pole are $\frac{L^{\frac{3}{2}} M^{\frac{1}{2}}}{T}$.

6. *Magnetic Field.*—It is clear that the presence of a magnet in some way modifies the surrounding space, since any other magnet brought into that space experiences a peculiar force. The neighbourhood of a magnet is, for convenience, called a magnetic field; and for the same reason the effect produced by a magnet is often spoken of as due to the magnetic field, instead of to the magnet itself. This mode of expression is the more proper, inasmuch as the same or a similar condition of space may be produced by the passage of electrical currents in the neighbourhood, without the presence of a magnet. Since the peculiarity of the magnetic field consists in the presence of a certain force, we may numerically express the properties of the field by measuring the strength and direction of the force, or, as it may be worded, the intensity of the field and the direction of the lines of force.

This direction at any point is the direction in which the force tends to move a free pole; and the intensity, H, of the field is necessarily defined as proportional to the force, f, with which it acts on a free pole; but this force, f, is also proportional to the strength, m, of the pole introduced into the field, and it depends on no other quantities; hence

$$f = m\,\mathrm{H}, \qquad (2)$$

and therefore the field of unit intensity will be that which acts with unit force on the unit pole.

The dimensions of H are $\frac{M^{\frac{1}{2}}}{L^{\frac{1}{2}}T}$.

The lines of force produced by a long thin bar-magnet near its poles will radiate from the poles, and the intensity of the field will be equal to the quotient of the strength of the pole divided by the square of the distance from the pole; thus the unit field will be produced at the unit distance from the unit pole. In a uniform magnetic field the lines of force, as may be demonstrated, will be parallel; such a field can only be produced by special combinations of magnets, but a small field at a great distance from any one pole will be sensibly uniform. Thus, in any room unaffected by the neighbourhood of iron or magnets, the magnetic field due to the earth will be sensibly uniform; its direction will be that assumed by the dipping-needle.

7. *Magnetic Moment.*—In reality we can never have a single pole entirely free or disconnected from its opposite pole, and it is time to pass to the consideration of the effect produced on a material bar-magnet in a magnetic field. In a uniform field two equal opposite and parallel forces act on its poles, and tend to set it with the line joining those poles in the direction of the force of the field. When the magnet is so placed that the line joining the poles is at right angles to the lines of force in the field, this tendency to turn or "couple," G, is proportional to the intensity of the field, H, the strength of the poles, m, and the distance between them, l; or

$$G = m\,l\,H. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$m\,l$, or the product of the strength of the poles into the length between them, is called the magnetic moment of the magnet; and from equation (3) it follows that, in a field of unit intensity, the couple actually experienced by any magnet in the above position measures its moment. The dimensions of the unit of magnetic moment are evidently $\frac{L^{\frac{5}{2}}M^{\frac{1}{2}}}{T}$.

8. *Intensity of Magnetization.*—The intensity of magnetization of a magnet may be measured by its magnetic moment divided by its volume.

The dimensions of the unit of magnetization are therefore $\frac{M^{\frac{1}{2}}}{L^{\frac{1}{2}}T}$, the same as in the case of intensity of field.

9. *Coefficient of Magnetic Induction.*—When certain bodies, such as soft iron, &c., are placed in the magnetic field, they become magnetized by "induction;" so that the intensity of magnetization is (except when great) nearly proportional to the intensity of the field.

In diamagnetic bodies, such as bismuth, the direction of magnetization is opposite to that of the field. In paramagnetic bodies, such as iron, nickel, &c., the direction of magnetization is the same as that of the field.

The coefficient of magnetic induction is the ratio of the intensity of magnetization to the intensity of the field, and is therefore a *numerical* quantity, positive for paramagnetic bodies, negative for diamagnetic bodies.

10. *Magnetic Potentials and Equipotential Surfaces.*—If we take a very long magnet, and, keeping one pole well out of the way, move the other pole from one point to another of the magnetic field, we shall find that the forces in the field do work on the pole, or that they act as a resistance to its motion, according as the motion is with or contrary to the force acting on the pole. If the pole moves at right angles to the force, no work is done.

The *magnetic potential* at any point in a magnetic field is measured by the work done by the magnetic forces on a unit pole during its motion from an infinite distance from the magnet producing the field to the point in question, supposing the unit pole to exercise no influence on the magnetic field in question. The idea of potential as a mathematical quantity having different values at different points of space, was brought into form by Laplace.* The name of potential, and the application to a great number of electric and magnetic investigations, were introduced by George Green, in his Essay on Electricity (Nottingham, 1828).

An equipotential surface in a magnetic field is a surface so drawn that the potential of all its points shall be equal. By drawing a series of equipotential surfaces corresponding to potentials, 1, 2, 3 . . . . . . n, we may map out any magnetic field, so as to indicate its properties.

The magnetic force at any point is perpendicular to the equipotential surface at that point, and its intensity is the reciprocal of the distance between one surface and the next at that point. The dimensions of the unit of magnetic potential are $\frac{L^{\frac{1}{2}}M^{\frac{1}{2}}}{T}$.

* Méchanique Céleste, liv. iii.

11. *Lines of Magnetic Force.*—There is another way of exploring the magnetic field, and indicating the direction and magnitude of the force at any point. The conception and application of this method in all its completeness is due to Faraday.* The full importance of this method cannot be recognised till we come to electro-magnetic phenomena (sections 22, 23, and 24).

A line, whose direction at any point always coincides with that of the force acting on the pole of a magnet at that point, is called a line of magnetic force. By drawing a sufficient number of such lines, we may indicate the *direction* of the force in every part of the magnetic field; but by drawing them according to rule, we may indicate the intensity of the force at any point as well as its direction. It has been shown,† that if in any part of their course the number of lines passing through unit of area is proportional to the intensity there, the same proportion between the number of lines in unit of area and the intensity will hold good in every part of the course of the lines.

All that we have to do, therefore, is to space out the lines in any part of their course, so that the number of lines which start from unit of area is *equal* to the number representing the intensity of the field there. The intensity at any other part of the field will then be measured by the number of lines which pass through unit of area there; each line indicates a constant and equal force.

12. *Relation between Lines of Force and Equipotential Surfaces.*—The lines of force are always perpendicular to the equipotential surfaces; and the number of lines passing through unit of area of an equipotential surface is the reciprocal of the distance between that equipotential surface and the next in order—a statement made above in slightly different language.

In a uniform field the lines of force are straight, parallel, and equidistant; and the equipotential surfaces are planes perpendicular to the lines of force, and equidistant from each other.

If one magnetic pole of strength, m, be alone in the field, its lines of force are straight lines, radiating from the pole equally in all directions; and their number is $4\pi m$. The equipotential surfaces are a series of spheres, whose centres are at the pole, and whose radii are m, $\frac{1}{2}m$, $\frac{1}{3}m$, $\frac{1}{4}m$, &c. In other magnetic arrangements these lines and surfaces are more complicated, but in all cases the calculation is simple; and in many cases the lines and surfaces can be graphically constructed without any calculation.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XVIII.

A.D. 18 1, December 21.—No. 9204.—Wright, Thomas, and Bain, Alexander.—"Improvements in applying electricity to control railway engines and carriages, to mark time, to give signals, and print intelligence at distant places," relating to:—

Controlling railway engines and carriages. "The deflection of the electric conductor, or a coil of wire," moves a dial hand, and releases a "stop," thus liberating wheelwork. A weight at the end of a lever acts on the stop disc through a rack head, pinion, ratchet wheel, and spur gearing. A stud on the lever is linked to the throttle valve lever and steam whistle, both of which are acted on when the stop is released, and the weight thus permitted to descend. "A pilot engine," with a "governor," propelled by the driving wheel axle, about a mile in advance, is used in connection with the above apparatus; the electric current from a battery on the locomotive passes through "brackets" and spring "plugs" to long conducting wires laid on the line of railway, thence through the governor rod to a coil of wire, and back to the battery through the line wires; as long as the current circulates through the coil, the "stop" prevents the clockwork from acting, but when the governor balls fall, a spring in the circuit presses against a piece of ivory on the governor rod, thus interrupting the circuit, and putting the mechanism into action.

"An electro-magnetic printing telegraph." Electro-magnets are arranged in the circumference of a circle, each having a "feeder," or armature fixed to a spindle, which is attached by means of a pin to the tail of the "type lever;" the type levers (mounted between "cocks") being all made to strike the paper and a blackened ribbon at the common centre of the magnets. There is also a central magnet that draws down the soft iron type lever heads

* Experimental Researches, vol. iii. art. 3,122 *et passim*.
† *Vide* Maxwell on Faraday's Lines of Force, Cambridge Phil. Trans., 1857.

when they get sufficiently near, and another to move the paper forwards, through both of which the current passes whenever the circuit is completed. The surface of the ribbon is rubbed over with a composition of oil, lamp-black, and spirits of turpentine; and the magnet that moves the paper forward has a "feeder" or armature connected with a lever and click working into a click wheel on the shaft of the paper roller.

A method of printing and giving signals; in which a spring barrel rotates the type wheel and brings the corresponding letter to the aperture in the dial by means of a coil acting on a ratchet wheel by pallets; a second spring barrel brings the type to the paper, and moves the paper by means of a governor (rotated by the first spring barrel, and mounted on a "friction collet"), which allows an excentric and ratchet wheel to act as soon as the coil has brought the desired type opposite the paper; for this purpose the governor lever bears against knees suitably fixed on the shaft of the excentric. The coil is only deflected when the circuit is completed.

An instrument to show whether a telegraph is indicating or printing correctly at a distant station. On the completion of the circuit, the battery current rotates a hand round a disc at the distant station, by the deflection of a coil from a permanent magnet acting on the spindle of the hand through a ratchet wheel and click movement. At certain positions of the hand, a battery at the distant station is brought into action by studs, over which an insulated metal curve on the hand passes; this battery deflects a small coil at the telegraphing station, the current being at such times insulated from the instruments, by a spring in the circuit pressing against a non-conducting portion of the ratchet wheel. At the telegraphing station a steel disc is used, with ivory studs inserted, which cut off the main circuit at each deflection of the needle. This instrument is employed to work the last-mentioned telegraphic printing apparatus.

The application of the deflection of a coil to the movement of timepieces. An electric current is sent through a coil every minute by means of a pendulum or balance wheel; every deflection of the coil moves a ratchet wheel forward one tooth by a click on the coil; this motion is communicated to the hands by the ordinary clock mechanism. Two coils working two ratchet wheels may be used instead of one in any of the above applications, one coil working at a time by the reversal of the current.

"Laying down the conducting wires for telegraphic purposes in asphalt, pitch, or any other cement," "by digging a trench," and filling it to a small depth "with the cement in a soft state. When this is hardened," the wires are laid on it, and another quantity of cement in a soft state is run in the trench, and on and over the wires.

Using "bodies of natural waters" to complete the electric circuit, by laying a single insulated wire between the given stations, having at each end a metallic brush immersed in the water.

A.D. 1842, January 15.—No. 9227,—Palmer, Edward.—"Improvements in producing printing and embossing surfaces," consisting of:—1st. "A mode of obtaining surfaces for relief printing by means of the electrotype process or by casting." A smooth plate of German silver or brass, blackened on the surface, either by means of a solution of chloride of platinum or of "hydro-sulphuret of ammonia," is coated with a composition of "the clear part of Burgundy pitch," resin, white wax, and spermacetti, and its surface whitened with finely powdered sulphate of lead; lines etched upon this surface appear dark upon a white ground. The whole plate is then electrotyped, being placed in the solution before the ground is made conducting; the ground is then plumbagoed, and the electrotype proceeded with. Or a plaster cast may be taken of the subject, from which a reverse cast for stereotyping may be had by rubbing the first with lather of soap and taking a plaster cast in the usual manner. 2nd. A mode of obtaining metallic printing surfaces with the design sunken. Drawings made upon prepared surfaces are electrotyped or cast in wax, from which electrotype or casting "as many printing copies as required can be taken." To make the prepared surface, a very thin coating of a mixture of white wax and sulphate of lead is poured over a metal plate, and a border made round it when cold; a sufficient quantity of white wax mixed with plumbago is poured on this, and the tablet is taken off the plate ready for use; the design drawn on this surface appears black upon a white ground. Or a cast from an oiled polished piece of metal or glass is taken in plaster of Paris, and the design drawn on it with a black lead pencil, then etched with an engraver's needle; while working, finely-powdered charcoal is dusted into the lines; this method is preferred. 3rd. A mode of obtaining, by the electrotype or stereotype, blocks for surface printing from engraved plates. Printer's ink, mixed with driers of Brunswick black, is spread carefully over the engraved plate, so as not to fill up the engraved lines, by means of a printer's composition roller; oxide of iron mixed with litharge, in fine powder, is sifted over this, the whole dried, and the powder brushed off. This process is repeated until a sufficient thickness is obtained, and the whole is black-leaded and electrotyped, or cast from in plaster. 4th. "Obtaining embossed surfaces" by "sinking the subject in a prepared surface of plaster of Paris" (see 2nd improvement), "and then, by obtaining a cast therefrom," producing "an embossing surface by the electrotype or by casting." If the surface is to be obtained by the electrotype, a wax mould of the plaster must be taken, but if by stereotype, a plaster mould.

A.D. 1842, June 1.—No. 9374.—Lesson, Henry Beaumont.—"Improvements in the art of depositing and manufacturing metals and metal articles by electro-galvanic agency, and in the apparatus connected therewith," consisting of:—1st. A galvanic battery, in which the trough contains two removeable frames—one resting on the bottom of the trough, and containing porous cells and partitions—the other resting on the top of the trough, and containing the metal plates. The porous cell frame is not wanted when only single fluid is used. The plates are secured to "bars," projecting inwards from the side of the frame, with screw clamps, in such a manner as to be removeable singly without disturbing the others. A voltameter is described and shown, that has great area of acting surface supported in a glass vessel from a metal cover. 2nd. Cleaning zinc and copper battery plates by electricity; by first removing the impurities by immersion in an acid or saline solution, in connection with the positive pole of a battery, and then (in regard to the copper plates only) electro-depositing copper on them. Also amalgamating zinc plates by the electro-deposition of mercury on them. 3rd. Battery exciting fluids to be used in connection with sulphuric, nitric, or muriatic acids. Ammoniacal liquor from gas works, lime liquor after use in gas purifying, alkaline sulphurets, the residuum of the "processes for making potash and soda," the sulphates of calcium, barium, and strontium, the alkalies and their carbonates, and "the acid solution of sulphate of iron" produced "in the manufacture of green copperas or sulphate of iron, in connection with any of the last-mentioned alkaline solutions or sulphurets." 4th. Adjusting or diminishing the "quantitative" or electrolytical effect of a battery, by increasing the number of pairs, there being not less than ten pairs used. 5th. Using glue, either alone or together with gums, resins, or a solution of tannin, to make elastic moulds for wax electrotype casts; and a strong solution of cyanide of silver and potassium to deposit upon the casts. To projecting parts a pin of metal is attached, which receives the rough deposit that would otherwise take place on the mould; the pin is afterwards cut off. Positive wires are led into cavities or undercut portions to cause an equable deposit, and conducting wires are inserted into wax moulds to facilitate deposition. 6th. Giving motion to the article to be deposited upon (not on its own axis) by means of a roasting jack, &c.; or the depositing solution may be agitated. 7th. Forming parabolic and other reflectors by first electro-depositing the silver or other face, and then a suitable thickness of copper; the face is then highly polished. 8th. Electro-depositing alloys. First method:—By using a solution composed of similar salts of the different metals, and as many distinct galvanic batteries as metals, all the negative poles being connected to the article to be coated, and each metal to a positive pole. Second method:—A beam, moved by any suitable power, alternates the battery connection with the metals; one or two batteries may be used. Third method:—One battery may be used, and a dissolving plate of each of the metals. Fourth method:—"Any of the non-metallic electrotytic" [electrolytic?] "fluids," described in the 11th improvement, may be used "in connection with any of the hereinbefore recited arrangements." 9th. Giving a coating of mercury by immersion to prepare metallic surfaces for electro-deposition. 10th. Arranging the articles to be coated themselves, "in series as a portion of the battery," so as to assist in generating and "maintaining the galvanic current." 11th. Electro-depositing metals "by the aid of electrolytic solutions not originally containing such metals;" proto-salts and "those that form double salts with the metal" are preferred, and the electric current must be intense enough. 12th. Manufacturing platinum and other metals from their ores by electro-deposition. The solutions named in the 11th improvement are, by preference, used. The metal may at once be deposited in the required form. 13th. Manufacturing platinum vessels, &c., by electro-depositing the metal upon a

suitable mould, which is afterwards removed; a platinum cathode is used. In electro-coating articles with platinum, they are previously plumbagoed or coppered. 14th. The application of certain compounds of the metals, not before used, to furnish an electrolytic solution for their deposition. "Sulphate of silver" is mentioned twice, and "sulphate of silver and soda," "sulphate of silver and potassa," "hypo-sulphate of silver and strontia," "racinate of silver," and "sulphoriarte of silver," are also mentioned; these are referred to in the "Memorandum of Alteration." Under this head, about 430 compounds of the metals not before used, are mentioned in the list.

A "Memorandum of Alteration" was enrolled by the Patentee, March 25, 1843, in which the sentences,—"sulphate of silver," "sulphate of silver and soda," "sulphate of silver and potassa," "hyposulphate of silver and strontia," "racinate of silver," and "sulphorinate of silver," occurring in the specification,—are altered into, "sulphite of silver," "sulphite of silver and soda," "sulphite of silver and potassa," "hyposulphite of silver and strontia," "racemate of silver," and "sulphovinate of silver," respectively.

A.D. 1842, June 4.—No. 9379.—Tuck, Edmund.—"Covering or plating with silver various metals and metallic alloys." This invention "consists in the use of either of the two carbonates of ammonia, namely, the sesquicarbonate and the bicarbonate as one of the ingredients in the mixtures or compounds employed for covering or plating with silver various metals and metallic alloys by the action of electricity." A process is described for plating "bad German silver," in which "sulphate of silver" is used in combination with "a solution of bicarbonate of ammonia" in "equivalent" proportions; for plating "on copper or on good German silver," "cyanide of silver" in "equivalent" proportions is used instead of "sulphate of silver." The inventor prefers to use a modification of "Daniell's constant battery," which is described as a suitable source of electricity for electro-plating by these solutions. The arrangement of the trough for plating, the method of cleaning the metal alloy to be plated, and the regulation of battery power to the article to be coated, is set forth.

A.D. 1842, August 1.—No. 9431.—Woolrich, John Stephen.—"Improvements in coating with metal the surface of articles formed of metal or metallic alloys." A magneto-electric machine is described and shown, consisting of a horseshoe-formed armature, revolving in front of a fixed horseshoe permanent magnet. The permanet magnet is adjustable to any required distance from the armature by means of a screw, and the electric currents are made to flow in one direction by means of a "dividor," which consists of a non-conducting collar fitted on to a brass tube fixed centrically to the armatures; one of the terminal wires is in connection with a brass semicircle on the collar, the other terminal wire is in connection with an opposite brass semicircle; two pairs of springs (fixed to the frame of the instrument by pillars containing binding screws), press alternately on the brass semicircles, one spring of each pair being on the wooden collar when the other is in contact with a brass semicircle, thus enabling each pair of springs to become a pole of the instrument, and a nearly continuous current of electricity to flow through the circuit when closed. Silvering, gilding, and coppering solutions, to be used in connection with the above magneto-electric machine, are described. The silvering solution consists of sulphite of silver (precipitated from the nitrate by sulphite of potash) dissolved in sulphite of potash, of which an excess is added. The gilding solution consists of oxide of gold (precipitated from a chloride by magnesia) dissolved in sulphite of potash, of which an excess is added. The coppering solution consists of carbonate of copper (precipitated from the sulphate by "carbonate of potassa") dissolved in sulphite of potash, of which an excess is added. The solvent solution above-mentioned (sulphite of potash) is made by passing sulphurous acid gas through a solution of pearlash, "taking care not to add sulphurous acid gas in excess.

A.D. 1842, September 8.—No. 9465.—Cooke, William Fothergill.—This invention "relates to the arrangement and disposition" of telegraph wires. The improvements consist of:—

Stretching, suspending, and insulating telegraph wires on posts and other suitable supports entirely of wood, or of wood and iron, erected at suitable distances. If the wires are required at an unusual height above the level of the ground, one pole is applied at the top of another in the manner top-masts of ships are placed on the lower masts, and they are properly stayed. To carry the wires beneath an arch, a piece or pieces of wood in an inclined position are used. The wires may either be placed one over the other, at one or both sides of the post, or on horizontal cross pieces fixed to one or more posts or supports. When the posts are necessarily at great distances apart, the wires may be kept at the required distance by glass tubes lashed to a bamboo rod. This improvement may be used alone or in conjunction with the methods of mounting and insulating telegraph wires set forth in Letters Patent, Nos. 7390 and 7614. At certain distances stronger posts are erected, to stretch the wire, so that they may hang parallel to each other. The following methods of straining the wires may be used:—"Winding up spindles with ratchet wheels and clicks," either fixed or removeable after the stretching; screw bolts and nuts with eyes to receive the wire; or "tackles or pullies in conjunction with holding tongs," or a bent lever in conjunction with a bolt having pin holes and an eye, may be temporarily applied; metallic contact between the wires being made through a piece of metal on which the ratchet wheels and clicks are mounted, or through which the bolts are fixed; or a copper wire may make metallic contact between the telegraph wires. Each drawing post may have stretching apparatus on one or both sides. When branch wires are required, the suspending or winding up apparatus on the nearest post must be mounted separately for each wire, so that the circuit is only completed through the signal apparatus. The insulation of the wires from the suspending and drawing posts, and from the earth, is accomplished by the following means:—The top of the post is enclosed in a wooden, glass, or earthenware case, the wires either being suspended on hooks outside the cases, or the cases having apertures for the wires; sheds may be used, with or without the cases, to "preserve a dry zone" around the posts between the wires, and one larger shed under the wires to keep them insulated from the earth; the wires themselves may be passed through tubes of glazed pottery-ware or glass, or a split goose quill fastened to the wire with white lead and twine; or the wires may be suspended under a shed by india-rubber loops and metallic S hooks; or the suspension hooks may be attached to glass tubes. The wires used may be either single wires of copper covered or not with thread and varnish, or iron wire painted and varnished; or compound wires of several wires twisted together with a central yarn of tarred hemp, or a central wire of copper, or a copper wire twisted amongst the iron wires may be used. The wire so stretched, suspended, and insulated, may be used for one half the telegraphic circuit, in conjunction with the earth circuit for the other half, instead of the "sixth wire" referred to in Letters Patent, Nos. 7390, 7614, and 8345. Distinct batteries may be used in conjunction with the suspension of the wires and the earth circuit, one to each wire, thus making as many electric currents available at one time as there are wires.

Communicating by electric means between any carriage in a railway train and the engine driver. Conducting wires, composed of two twisted copper wires woven into a web or threadwork, well coated with india-rubber, are extended over the tops of the carriages, and have branch wires proceeding to each carriage connected respectively with springs that can be brought into contact when required, thus actuating a battery and alarum (See Letters Patent, No. 7390) placed in the front carriage. A wooden roller (through whose pivots and standards the proper connections are made) is mounted over the alarum for the purpose of winding up the web.

The above-described improvements may be applied to communicating action from one regulating clock to other clock trains, to ensure their moving uniformly, also to printing telegraphs, and to releasing mechanism by means of electricity. Constant reference is made in the Specification to Letters Patent, Nos. 7390, 7614, and 8345.

BALLOON ASCENT FOR SCIENTIFIC PURPOSES.

At the last meeting of the British Association the balloon committee were charged with experiments to be made at times in the year and at times in the day at which no experiments have hitherto been made, particularly at night and in the winter months. No arrangement has as yet been made to take night observations, but those of the winter have been determined upon.

The first of these took place from Woolwich Arsenal on the 1st day of this month, and is thus described by Mr. James Glaisher:—In consequence of the balloon prepared for these experiments having been wantonly destroyed at Leicester, at a Foresters' fête, we are compelled to use the best balloon Mr. Coxwell has; with this we cannot hope to ascend more than 1½ miles or 2 miles; and if, as on this occasion, the course of the balloon is towards the sea, not even that elevation can be attempted but at the cost of the greatly abbreviated time for observation, and the sacrifice of all results excepting those connected with temperature. If with the small balloon our course should at any time be inland, both objects can be

secured by keeping the gas at the first part of the journey, and ascending to the limit to which the balloon will take us just before descending.

The balloon left at 2h. 37m., with a temperature of 48°, which remained unchanged till 600 feet were passed; it then declined gradually to 31½°. at the height of 5,200 feet by 2h. 58m.; on falling to 4,000 feet the temperature increased to 39½°, and declined to 30° at 5,000 by 3h. 26m.; on descending to 4,200 feet there was an increase of 2° and a decline to 29° to the height of 5,400 feet by 3h. 42m.; then a gradual increase to 41° at 1,400 feet; then no change on descending through the next 600 feet, when the last observation was made at 4h. 23m.; and we were on the ground at 4h. 25m., when it was too dark to read the instruments.

The temperature of the dew-point, or that temperature at which the water in the air is deposited visibly upon substances cooled down to that degree, as the bright metallic cups of a hygrometer, was 8° below that of the air from the earth to the height of 1,500 feet; the air then became much more humid, and at 2,100 feet the difference of these two temperatures was 5° only. On passing into a W.N.W. current, at 2,300 feet, the difference between these became 11°, and was nearly 20° at the height of 5,000 feet, when the air was very dry. On descending, the two temperatures approached again, and at 4,000 feet high were separated by 10° only. On again ascending, the difference increased to 23°, the temperature of the air being 32°, and that of the dew-point 9°, and it continued dry at high elevations. On descending below 3,500 feet, at 3h. 53m., the air again became humid, and continued so at all lower elevations, particularly between the heights of 800 and 1,200 feet, where the two temperatures were nearly alike, and the balloon was covered with water. Some strata of wet air were passed of no great thickness, without perceptible fog, depositing a good deal of moisture.

The reading of a delicate blackened bulb thermometer, placed in the full rays of the sun, which read 56° before starting, never read so much as 1° higher than another delicate thermometer, most carefully protected from the sun during the whole journey. The bulbs of these two thermometers were within two inches of each other. No tinge of ozone was shown throughout the journey. When at the height of 3,000 feet, the concussion from proving guns at Woolwich affected the balloon, and caused every rope to vibrate perceptibly and all the instruments to move, and this took place each time a report was heard, even up to the height of 5,000 feet. Once no less than three echoes were heard following a report, but usually one report only was heard.

A very delicate magnet, sent to me by Captain Evans, R.N., F.R.S., which vibrates in a little more than two seconds on the earth, was observed on ten different occasions, and the time of vibration appeared to be lengthened, notwithstanding the lower temperature of the higher regions. Another magnet, less delicately mounted, and which I have frequently used, also occupied a somewhat longer time in vibrating.

For an altitude of 20° all round there was mist; the remainder of the sky was for the most part clear. On examining the sun with a spectroscope over the earth, the colours of the spectrum were moderately bright; the line B at the red end, and G at the violet end, were the extreme limits, and there were not many besides the principal lines between; the wind was nearly W. near the earth. On reaching 1,100 feet we entered a S.W. current, and thought we should cross the river Thames north of Erith; but on passing above 2,000 feet we entered a W.N.W. current, and passed at 3h. some little distance south of Erith, and over Dartford at 3h. 16m., and here we saw the smoke from Gravesend passing southward, or S.S.W., till it reached 1,000 feet, and then to turn back upon itself. At this time, at the height of 5,000 feet, we were moving W.N.W., or towards Cobham Park. At 3h. 34m. we were south of Greenhithe, and nearly over Darent Wood. On examining the country, it had an appearance we had never seen before. At the height of a mile up to this time all hills have been dwarfed to level plains, and all valleys have been raised, so that the earth has appeared uniformly plain; on the contrary now, every variation of surface, every hollow, every rise were clearly shown; the course of the river Darent was traced for miles, with every elevation of land near it, but we could not see anything moving on the earth. The sun was shining, the sky was perfectly clear and of a deep blue. On examining the sun's spectrum here, it was ~~indeed different from below~~; the colours were all far brighter, the lines very numerous, extending from A at the red end to far beyond H at the violet end, which line was made up of fine lines. The spectrum was very fine. The sun was warm, but yet did not exercise any influence on the thermometer, upon the blackened bulb of which it shone brightly; at 3h. 46m. there was a sudden chill to sense; the wind was still W.N.W., and Mr. Coxwell, (who watched the direction and motion of smoke, the angle we made with known roads on passing them) with great judgment kept within its influence, so as to drive us inland, for, he remarked, if we sank to the lower current, to the sea we must go. At 3h. 58m. we heard a clock strike four. We were then a little south of Nursted. At 4h. we were south of Gravesend; at 4h. 17m. we crossed the Medway; then over Woldham, changed our direction to south-west nearly, and were on the ground at 4h. 25m., at Delce Farm, near Rochester, and received assistance from Mr. Matson, whose farm joined that on which we fell, for which we beg to thank him. The inhabitants at Gravesend and Rochester were greatly puzzled at our moving directly opposite to that of the wind where they were, and some thought we had a power of guiding the balloon.

During this ascent we hugged the river Thames all the way down. Mr. Coxwell felt that he dare not ascend higher than one mile, on account of the loss of gas we should have experienced in so doing, till we could pass Gravesend; and when we did so it was too dark. At 4h. 23m., at my last observation, it was very difficult to read the instruments, and it was then no use to ascend higher or to remain longer from the earth.

The balloon was seen from the Royal Observatory, Greenwich, at 2h. 40., when 1,000 feet high; it was watched by Mr. Nash till 3h. 8m., and up to this time he noticed that the balloon moved one-half round between 2h. 45m. and 3h., and then back again in the contrary direction; and at 3h. 8m. he could read the word "Mars" on the balloon distinctly with a telescope.

Simultaneous meteorological observations were made at the Royal Observatory, Greenwich, by command of the Astronomer-Royal, under the superintendence of Mr. Nash, and also at my residence by Messrs. Yair and Howe.

THE MANUFACTURE OF MAGNESIUM.

It is now pretty generally known that by a recent discovery magnesium can be used as an illuminating agent. Its properties in this respect are so great that photography, as applied to portraiture, can, with its aid, dispense with the light of the sun. It is not so generally known that the only establishment for the manufacture of the metal is in the borough of Salford. A few months ago it was stated in our columns that the existence of the metal was known to Sir Humphrey Davy more than fifty years since. He obtained it by electricity, in small globules, and his acquaintance with it ended there. Since that time magnesium has been produced by other chemists, usually by the action of electricity; but the metal has not, until within the last two years, been produced in such quantities as to make it available for the increase of the comfort or the luxury of mankind. It is now manufactured successfully, a second step in respect to it being thus made; and a further advance remains to be made, namely to discover to what purposes, other than photography, it may be applied. Mr. Edward Sonstadt, an English gentleman of Swedish descent, after much study and many experiments, recently discovered a comparatively inexpensive mode of making magnesium in large quantities. His patents for the process were purchased by the Magnesium Wire Company, whose works in Salford are the only manufactory of the kind in the world.

The basis of the manufacture is the mineral of which dolomite mountains are composed. It is found in the north-east of this country in combination with lime, constituting magnesian lime-stone, from which, however, the metal is not so readily extracted as from the carbonate of magnesium imported from Greece. There is also a range of hills in India that consists of carbonate of magnesium. In the ocean, magnesium exists in such quantities that Mr. Sonstadt estimates, if it could be brought together, it would make a mountain of magnesium more than fifty-four miles high, and as many square.

The process by which Mr. Sonstadt produces the metal is as follows:—The lumps of the carbonate of magnesium are placed in large earthenware jars with a quantity of muriatic acid. The solution thus obtained is drawn off when clear, and mixed with a solution of chloride of sodium or potassium. This mixture of magnesium and the alkaline chorides is subjected to heat in porcelain basins until the moisture is evaporated. The dried mass remaining is fused in a platinum crucible, and when poured out is technically known as "material." To deal with this a furnace is required, and the aid of sodium, which has already enabled chemists to obtain one of the latest metallic contributions to civilization, namely, aluminium. So important is the part played by sodium, that upon its price almost entirely depends the cost of magnesium. To make the latter cheap enough to be generally useful, it will be necessary to discover some less expensive mode than the present of obtaining sodium, and we believe this is likely to be done shortly. The "material" is placed in an iron crucible with a quantity of sodium, and heated to redness. The consequence is that the chloride of magnesium is decomposed, chloride of sodium is formed, and magnesium is liberated in its metallic state. The specific gravity of the metal is so light, being only 1·74, or little more than half of that of aluminium, that a large portion of the magnesium is found, when the crucible has cooled and been opened, on the surface of the salts, and in the form of compressed spheres. The remainder of the metal is held by the flux, in globules varying in size from that of a microscopic sphere to that of a nut. The metal thus obtained is still unfit for commerce, being brittle and unworkable. It has to be still further purified by distillation, and this is accomplished on the same principle (though necessarily on a much smaller scale), by which mercury is released from the ore cinnabar. An inverted iron jar rests upon the elongated cover of a small cast-iron box. A tube passes through the centre of the jar, and forms a communication between it and the box. The crude metal is placed round the tube, which reaches to within an inch of the lid, and the jar is placed in the furnace, the elongated lid of the lower box resting on the fire bars, and thus the box is below, and is comparatively cool. The heat volatilises the metal, which condenses in the lower vessel, and the product thus distilled is almost chemically pure. It should be stated that the air is excluded from these vessels; if it was admitted, the magnesium would burn.

The metal thus formed in solid blocks is taken to the Salford Ironworks, arrangements having been made by the Company with Messrs. Mather and

Platt for the conversion of the lumps of metal into wire and ribbon. The blocks are washed, to cleanse them from dirt and oxide, and are broken into small pieces. To convert these into wire an ingenious machine has been devised. The chief feature of it is a small hollow cylinder, adapted to receive a ram at one end, and covered at the other by an iron screen, perforated with two or more holes opposite the chamber. This press, as the cylinder is called, is subjected to the action of gas from a blowpipe, and the heat employed is only what suffices to soften the metal in the press. The small lumps of magnesium are thrust into the chamber, the ram is placed in the mouth of the press, and a pressure of between two and three tons (at present obtained by hydraulic apparatus, but which may, of course, be provided by steam), forces the ram against the softened metal, and the latter oozes in continuous strings of wire through the perforations already named. To make ribbon, the wire thus obtained is passed between two hollow, heated rollers, and is received in a flattened state upon a reel.

The only use, as we have stated above, to which the wire has been yet applied, has been for illumination. Mr. Brothers, of this city, was the first to adapt it for taking portraits by night; and in dull or foggy weather the burning of a small portion of the wire greatly assists the action of the sunlight for photographic purposes. Recently Mr. C. Piazzi Smyth, the professor of practical astronomy at the University of Edinburgh, sailed from Liverpool for Egypt. He has been supplied with quantities of the wire and every other requisite; and it is his intention to photograph the interior of the pyramids. It is manifest that such an undertaking can only be accomplished by an instrumentality like that which magnesium affords, and we wish the learned professor every success. By the aid of magnesium the interiors of caves and mines may be distinctly seen and photographed. For signals it is hoped that it will prove of great service. The magnesium light has been seen at a distance of twenty-eight miles at sea. Its applicability is now being tested in various ways by Government authorities and by chemists throughout the world; and we may confidently expect ere long many adaptations to use will be found of this practically new contribution to modern civilisation. Mechanical lamps have been devised for burning the wire, but at its present cost it cannot be extensively used for this purpose. The metal takes a fine polish under the burnisher; it does not clog the file; and when hot it is very malleable. Exposure for some time in moist air will tarnish it, but it is not affected by the action of sulphuretted gases. Articles of jewellery have been made from it, and a medal of magnesium has been struck; but its principal known use, as already stated, is as an illuminating agent.—*Manchester Guardian.*

CORRESPONDENCE.

MR. ROSENBUSCH'S NEW BATTERY.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I beg leave to bring under your notice, for the benefit of the readers of your journal, the description of a new kind of battery, which it is very easy to construct anywhere, and regardless of peculiarly shaped metals, and which entirely dispenses with the porous cell, the source of so much annoyance and resistance.

My battery is more or less analogous to that of Minotto, of Turin, but presents over this some marked advantages.

The outer vessel is the usual cylindrical glass jar commonly used for the Daniell battery. The positive element of the battery is a flat and very thin copper disc, to the middle of which is rivetted and soldered a copper wire, serving as electrode; this copper disc is placed horizontally at the bottom of the glass jar between two layers of sulphate of copper of one centimetre thickness each; the electrode is, therefore, in a vertical position, and in the axis of the glass jar. This copper electrode is surrounded with a tube of glass or gutta-percha of 1½ centimetre diameter, which reposes on the upper layer of sulphate of copper.

Over the two layers of sulphate of copper I place a disc of coarse linen, over this a thick layer of common sawdust, and then again a disc of coarse linen, on which latter reposes the cast zinc disc, which ought to be of nearly the diameter of the glass vessel, rather thick, and having a hole in the centre large enough to let pass the glass tube, which is firmly kept in the axis of the glass vessel by the surrounding sawdust and the zinc disc itself.

The object of this glass tube is to establish a communication with the lower part of the glass vessel, and to admit of adding sulphate of copper or water to compensate for consumption and evaporation.

The advantages of this arrangement are the following. I am enabled to *add* sulphate of copper to replace that consumed, and water to prevent the crystallization of the sulphate of copper, which otherwise, as in M. Minotto's arrangement, might form an impenetrable crust, which would entirely or partly suppress a communication between the two liquids and the metals placed therein.

The linen discs effectually prevent a mixture between the sawdust and the sulphate of copper.

No local action can take place as in the common Daniell, where the electrode of the zinc is generally a strip of copper soldered and rivetted to the zinc itself, which forms one of the weak parts of that battery, unless the contact place between the two metals is well coated with shellac or other isolating substance, which is a tedious and too often neglected procedure, because the electrode of my zinc is a narrow strip of zinc rivetted twice below the zinc disc, and again on the circumference of the same, thus ensuring an excellent contact.

The internal resistance of my battery can be varied at pleasure, be it by diminishing or increasing the layer of sawdust, or be it by increasing the size of the glass vessel and metals.

I beg to add, that I have experimented this battery for a long time, and have employed it (viz., 36 elements) to work a system of eight electric lantern clocks, in the town of Valetta, from 9th May, 1864, up to the present day, and intend to let it continue this incessant service to the end of the present year.

The only care bestowed on it has been to add from time to time some water to that in the zinc compartment, and to pour monthly some concentrated solution of sulphate of copper through the glass tube on to the copper disc, but even this slight inconvenience could be remedied by having a water bottle plunging into the liquid surrounding the zinc, which would supply the water as it evaporates.—I am, Sir, very faithfully yours,

EDWARD ROSENBUSCH.

Mediterranean Extension Telegraph Company,
27, Strada Stretta, Valetta, Malta.

THE ATLANTIC TELEGRAPH ENTERPRIZE.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—It was with more than ordinary pleasure that, on opening No. 47 of your interesting journal, I read the heading to one of the papers—"Atlantic Telegraph Enterprize,"—expecting, of course, a thorough account of the construction of the cable, &c., &c., so you may imagine my disappointment when, instead of a scientific treatise, I found a——I'll call it an essay, for such it appears, in more senses than one.

After reading the first few lines I skipped a paragraph, hoping to find that, like an organ-grinder with his monkey, "Amicus" was merely playing a prelude while the audience was collecting, before performing with the monkey, but for three weeks we have had to submit to his buffoonery. I could make nothing of it. It was a jumble of silly exclamations, would-be-funny sayings, with here and there a few technical terms which he has heard, and, parrot-like, repeats. He informs us, in paper No. 2, that he intends taking a plunge, and this he did with a vengeance, if we may judge by effect, for he certainly got out of his depth. He further tells us that he is young. Well, that, of course, is no reproach; nor can we blame him for wishing to appear in print; but, Sir, I think he might have chosen a more suitable place from whence to leap into immortality—for leap he must, if he will attempt it, since he is not yet in possession of the "pinions of Fame." One thing surprises me. It is that he should have had sufficient sense to conceal his name. I am forcibly reminded of those lines by Byron, ending thus:—

> "And yet, whoe'er he be, to say no worse,
> His name would bring more credit than his verse."

A new thought has struck me! Can it be that this is a practical illustration of some idea of his to make science amusing? We all know that young gentlemen of a certain age abhor anything appertaining to science on account of its supposed dryness; and many have resolved to reform and make grammar interesting. Who shall say what great inventions are not seething in the brain of "Amicus?"

I am, Sir, your obedient servant, J. P.

DANGEROUS CHIMNEYS.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Will you allow me an answer to a paragraph in your journal of the 26th ultimo, headed "Dangerous Chimneys." I cannot see how the cramps on a chimney-top can be a conductor, as they are generally let into the stone and covered with cement; even if they were exposed there is no connection with the earth, only the chimney, which is a bad conductor. As to gas being a good conductor of the electric fluid, how is it that when a chimney is struck the lightning never passes down the inside of it? I have seen a chimney that was struck which had four strong bolts twelve feet long connected with the cramps, and run down inside the flue of the chimney, and yet there was no trace of fluid inside; but there were large masses of stone cut out at intervals on the exterior of the chimney, from the top to the bottom. Again, there is a large number of chimneys with massive cast-iron cups or cornices, and they seem to escape the stroke as much as the stone or brick tops. But there need be no dangerous chimneys at all, if builders would only provide them with proper lightning-conductors.—Yours truly,

S. SANDERSON.

Victoria-buildings, Huddersfield, Dec. 3, 1864.

A NEW INVENTION FOR EXTINGUISHING FIRES.—A new invention for extinguishing fires has just been tried at St. Petersburg. About 130 lbs. of a white powder were dissolved in a vessel containing 200 gallons of water. A large wooden building two storeys high was then set on fire, and the liquid being pumped on the flames, they were extinguished without the least generation of vapour or smoke. The wood attacked by fire was covered after having undergone the action of the liquid, with a light coating resembling varnish.

TELEGRAPHIC NEWS.

New Zealand Telegraphs.—The receipts of the Canterbury line of telegraph for the year ending 30th June last amounted to the sum of £2,226; for the corresponding period of the previous year £800.

Indo-European Telegraph.—This line is complete between Bombay and Teheran, and works satisfactorily. Teheran is in communication with St. Petersburg, but the working of the line through the Russias cannot be relied on.

Failure of a Telegraph Cable.—Our Parisian correspondent writes on the 7th instant:—"I am informed that the Italian Government submarine telegraph cable from Cagliari (Sardinia) to Urepani (Sicily) ceased to work on the morning of the 30th November last."

Electric and International Dramatic Club.—An entertainment will be given by the members of the above society of amateurs on the 15th instant, at the Cabinet Theatre, Liverpool-street, King's-cross. The programme is of a very attractive character, and includes a performance of "Advice Gratis," "Done on Both Sides," and the "Artful Dodge." A notice of the entertainment will appear in our next.

Indian Telegraph Lines.—The *Bombay Gazette* announces that a violent gale has destroyed all the lines, including the span across the Kistna (Deccan). Communication has ceased in every direction. Masulipatam is reduced to a complete wreck by an inundation. Thousands of lives lost. It is rumoured that the telegraph-office is destroyed. Steps taken to re-establish communication on the 2nd November, and arrangements made to open a temporary office on the opposite bank of the Kistna.

The Overland Telegraph to America.—At a dinner given in honour of Dr. Rae's visit to Victoria, the gallant explorer said, "As to the telegraph, to show that it was a *boná fide* scheme, he might state that 600 miles of wire had already been landed in Canada, 600 at Yorke Factory, Hudson's Bay, and 600 miles more were *en route*. The connection would be made through from Canada, if the Government of the provinces would assist the undertaking; and if not, the line would still be carried on from Red River.

Serious Accident to a Telegraph Clerk.—On the morning of the 1st instant, an accident occurred at Greenhill Junction, near Denny, by which a young man named David Sheppard, telegraph clerk, was seriously injured. It would appear that he had got upon an engine which was employed shunting waggons, and in leaping off while it was in motion, he did so with his face towards the tender, and was thrown violently to the ground. The consequence was that he was completely stunned, and his right arm falling upon the rails one of the wheels passed right along it from the hand to the shoulder and crushed it to a perfect jelly. Drs. Benny and Cuthill from Denny were soon in attendance, and with the assistance of other two medical gentlemen from Falkirk, amputated the injured limb.

The Telegraph at Paraguay.—From Paraguay it is announced that the telegraph wires were laid down to Villetta, and opened to service on Sunday, the 16th October. The first despatches sent were the following:—"To His Excellency D. Francisco S. Lopez, President of Paraguay.—Telegraph Station, Villetta, Sunday, October 16, 7.15 A.M.—With great joy and profound respect, I send your Excellency the first despatch of the telegraph wires in Paraguay, with my sincere congratulation for the happy anniversary of the second presidency. May God preserve you many years.—Hans Fischer." ("Received R. T. Truenfeld.") "Government House, Asuncion, October 16.—His Excellency President Lopez has received with great satisfaction the first telegram, dated at 7.15 this morning, from Villeta, commemorating the Presidential anniversary, on occasion of inaugurating the telegraph wires in the republic. His Excellency desires me to congratulate and thank Mr. Hans Fischer, as also the director, Mr. Truenfeld, and staff of the telegraph company, for the happy issue of their labours.—Francisco Sanchez."

The Telegraphic News Association, Limited.—This company, with a capital of £50,000 in £5,000 shares of £10 each, proposes to furnish the press and the public of England, the continent of Europe, and the Western world with a fuller and more regular supply of telegraphic intelligence than the present system provides. The promoters state that, after much preparation and expenditure, and favoured by circumstances of an exceptional nature, they are in a position to undertake this responsible function with the certainty of being able to execute it in a complete and effective manner. Distributed at all points within the range of the electric wire, where the most important intelligence, political and commercial, is to be obtained at first hand, a staff of experienced correspondents has been organised, whose established relations with authentic sources of information insure a priority of intelligence upon which implicit reliance may be placed, and whose tried discretion and activity offer the safest guarantees for despatch and punctuality. Special arrangements have been made for procuring early and accurate, and in many instances exclusive, information in connection with the American civil war, and the progress of the new Mexican empire; while from China and the East Indies intelligence will frequently be transmitted, *viâ* St. Petersburg, when other sources of information are silent. A careful estimate has been made of the probable financial results of the undertaking, assuming the highest scale of expenditure and the lowest of receipts. The conclusions arrived at justify the anticipation of a large return upon a small outlay. The head office of the Association for England and the Western World will be in London, and for the Continent of Europe in Brussels. There are several good names on the list of directors, and with fair management this project may prove very successful.

Fire in the Leeds Office of the United Kingdom Telegraph Company.—In the afternoon of the 4th instant, a fire broke out at the office of the United Kingdom Telegraph Company, Park-row, Leeds. It appears that shortly after one o'clock, as a man was employed coating with gutta-percha several of the wires in the test-box, the lighted naphtha lamp which he used in the operation accidentally fell from his hand and ignited the gutta-percha. In an instant the wood work of the test-box was on fire, which rapidly communicated to the surrounding articles, and before the brigade could be procured the office was filled with smoke and flames. On the arrival of the firemen an abundant supply of water was found on the premises, and the conflagration was extinguished before much damage was done to the valuable telegraphic instruments—twenty-two in number—which were in the room where the fire originated. The immediate result of the fire was to injure the wires connecting the instruments with the exterior wires, and thus to stop all communication; but this was quickly obviated so far as London was concerned by the somewhat novel expedient of conveying an instrument to the roof of the premises, and placing it in connection with the wires which hang immediately above. The damage is estimated not to exceed £20. We understand that communication with all the company's stations was resumed on the morning of the 5th instant.

The Persian Gulf Telegraph.—The following communication has been received in reference to the Persian Gulf telegraph, from Major J. U. Champain, R.E., Director Persian Telegraphs, to the Chief Secretary to the Government of Bombay:—"Teheran, September 27, 1864.—Sir, I have the honour to report very briefly, for the information of the Government of Bombay, that the line of telegraph is now completed between Bushire and Teheran, and works most satisfactorily. Between this and Bagdad some ten days' work remains to be done; but we shall not be allowed to join up the wires, which have been cut near the frontier of Turkey, until the boundary question has been decided. I shall, however, try to organise a system of Sowars to carry messages between Kasr Sheereen and Khanakin (a distance of twenty miles) three or four times a day. In case I succeed the expenses will be a mere trifle, and messages between England and India would not be delayed more than three or four hours at the frontier. Should this proposal not be agreed to, important messages can still be sent to England *viâ* St. Petersburg, which is now in telegraphic communication with Teheran. I shall have the honour to submit my detailed report of operations in connection with the construction of the Persian line as soon as it is entirely completed. I have the honour to be, &c., J. U. Champain, R.E., Director Persian Telegraphs."

The Indo-Ottoman Telegraph.—A convention has recently been concluded between her Majesty's Government and the Porte, on the subject of the Indo-Ottoman Telegraph. The Ottoman Government binds itself, at its own expense, to extend and keep in repair to the mouth of the Shatt-el-Arab the great telegraphic line now completed from Scutari to Bagdad, and to connect the line in the direction of Khanakin with the Persian wires now communicating with the submarine cable at Bushire. The Indian Government on its part is to make a line from some point of British India to the mouth of Shatt-el-Arab. At the latter point a mixed station is to be established for the exchange of messages. The Turkish Government is to have officials acquainted with the English language. Art. 9 provides:—It is agreed by the high contracting Powers that the charge on the Indo-European despatches transmitted on the Ottoman lines of Asia through the entire course between Constantinople and Fao, or to the Persian frontier, in the direction of Khanakin, and *vice versâ*, shall not exceed 22f. 50c. or a simple message sent from Constantinople to Khanakin, or *vice versâ*; and similarly, that the charge on the despatches, by the entire submarine line from India to Fao or to Bushire, and *vice versâ*, shall not exceed, the first the sum of 62f. 5c. and the last that of 50f. for a simple despatch.

MISCELLANEA.

Curious Natural Phenomenon.—A writer in the *Zoologist* for November states that the Channel Islands are gradually sinking into the bed of the sea.

The India Rubber, Gutta Percha, and Telegraph Works Company.—During the past few weeks one of Gisborne's ship-steering telegraph instruments has been in operation at the offices of the company, and thousands of persons have crowded round the window in Bishopsgate to get a glimpse of the apparatus, which is at work showing the various signals, by means of a current conveyed from some distant part of the building.

The Last Folly of The French.—Common fame asserts that the silent system is about to be introduced into the club life of Paris, possibly as a punishment for the numerous scandals which daily issue from those select societies.—"Le Club Muet" is to be the title of this rather novel place of social meeting. Conversation is to be allowed on the steps; and members will be permitted to ask for letters in the hall; but once the door which admits him into the "realms of silence" has swung behind the elected member, he must not speak! He may eat, drink, sleep—if he does not snore—play whist, and smoke. He must not, however, indulge in dominoes, or "call the rattling main." Of course, if Pedro do Ponce had been alive, he would have been the active member of the committee of this secret society. It will be a droll sight to see the good company telegraphing for their dinner, and finding fault by signals with a bad cigar or a corked bottle.

THE EXPORTS OF INDIA-RUBBER AND GUTTA-PERCHA FROM SINGAPORE.—The value of caoutchouc exported from Singapore to the United Kingdom in 1861 was £95,116 against £70,413 in 1862, thus showing a decrement of £24,703. The value of gutta-percha exported in 1861 was £124,318; in 1862, £155,397 giving an increase of £31,079.

A NOVEL PRESENT.—A miniature telegraph office, designed for a present to the Emperor of Russia, has been prepared by an artizan of New York city. It consists of a complete telegraphic apparatus, capable of transmitting messages between New York and Boston, all embraced within the compass of a morocco case eight inches in length, six inches in width, and three and a half inches in depth.

PREPARATION AND PURIFICATION OF MAGNESIUM.—Mixed solutions of chloride of potassium and chloride of magnesium are evaporated to dryness, and thus a non-aqueous double salt is obtained, which, when reduced with soda in an iron crucible, yields large quantities of magnesium. It may be purified (though for photographic purposes this would be superflous, and enhance the cost of production considerably), by distillation in an iron apparatus filled with hydrogen.

A SUSTITUTE FOR INDIA-INK.—A substance much of the same nature and applicable to the same purposes as india-ink may be formed in the following manner:—Take of isinglass three ounces: make it into a size by dissolving over the fire in six ounces of soft water. Take then Spanish liquorice one ounce, dissolve it in two ounces of soft water over the fire in another vessel, then grind up on a slab with a heavy muller one ounce of ivory-black with the Spanish liquorice mixture. Then add the same to the isinglass size while hot, and stir well till thoroughly incorporated. Evaporate away the water, and then cast the remaining composition into a leaden mould slightly oiled, or make it up in any other convenient way. This composition will be found quite as good as the genuine article. The isinglass size, mixed with the colour, works well with the brush. The liquorice renders it easily dissolvable, on the rubbing up with water, to which the isinglass alone would be somewhat reluctant; it also prevents it cracking and peeling off from the ground on which it is laid.—*British Journal of Photography.*

THE ELECTRIC LIGHT FOR LIGHTHOUSE ILLUMINATION.—The magneto-electric light, invented by Professor Holmes, and tried in 1858 at the South Foreland, has been in constant use at Dungeness since 1862. At this place there are in the lantern two lenses, fixed one over the other, and two regulators to each. It appears from Mr. Holmes's statement, in a discussion at the Society of Arts, that only one light is shown at a time, but there are two regulators for each lens, so that an instantaneous change from one to the other can be made without extinguishing the light when fresh carbons are required. Two magneto machines are placed in the machine rooms. A steam engine forms part of the apparatus required for producing the electric light, and at Dungeness a direct-acting steam-engine and two boilers are attached to each magneto-electric machine. These machines contain 120 horse-shoe magnets, of about 50lbs. each in weight, and 160 helices. Mr. Holmes states that the light thus produced has all the steadiness and uniformity required for lighthouse purposes, and has this decided claim over other systems—it can be extinguished in an instant. One obvious disadvantage in the magneto-electric light is that in consequence of steam power being required it cannot be brought into practical use on rock stations, such as the Eddystone or Bell Rock.

A NEW THERMOGRAPH.—M. Marcy has addressed to the Academy of Sciences the following description of an instrument for marking small variations of temperature:—1. The first part of this thermograph consists of a copper tube a metre in length, the interior diameter of which is capillary, not being more than one-fifth of a millimetre. It is open at one end, and soldered to a hollow copper ball at the other end. 2. The second part of the apparatus consists of a wheel resting upon knife edges, like those of a pair of scales, whereby a very delicate oscillation may be imparted to it. The axle of the wheel carries a long vertical needle, marking the degrees on a circular scale. To the circumference of the wheel is fixed a glass tube six millimetres in diameter, and bent in conformity to the curvature of the wheel, and so situated that the middle of the tube lies vertically underneath the needle when the wheel is at rest. One of its extremities is hermetically closed, while the other is open. Now, if a little mercury be poured into this tube it will settle at the lowest point, and the interior of the tube will thus be divided into two chambers, one closed and with air confined in it, the other open. 3. Now introduce the copper tube into the glass one, giving it of course the same curvature, and so that its extremity may pass through the mercury, thus establishing a communication between the hollow copper ball and the confined chambers, and the apparatus, with a few accessory appliances, will be complete. The end of the copper tube dipping into the mercury should be varnished to prevent its being attacked by the latter metal; or better still, the end might be made of platinum. 4. To use this apparatus, put your hand to the copper ball; the warmth thus imparted to it will dilate the air it contains, and drive part of it into the confined chamber; the mercury will therefore recede, and thereby make the wheel turn round its centre of gravity; the very small arc thus described will be revealed by the needle, the difference of its present position with its previous one when at rest. If, on the contrary, the copper ball be cooled, by water for instance, the air inside will be contracted, a portion of the air of the confined chamber will rush in, and the mercury will be driven forward, the needle turning in the inverse direction. By means of this experiment very delicate physiological experiments on animal heat may be conducted.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

2980. A. E. Dobbs, B.A., taking deep sea soundings without the use of a line, and for bringing up specimens of the sea bottom and sea water from the greatest depth.

2997. J. Sax, the improvement of electric fire buttons and indicators, capable of being used in private houses, public places, on board ships, and on railways.

3016. J. W. Proffitt, improvement in railway carriage and passenger signals.

GRANT OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2826. C. Cotton and W. Nunn, improvements in apparatus for facilitating communication between passengers and guards of railway trains.

PATENT SEALED.

1442. J. Williams and T. Robinson, improvements in annealing wire.

PRICES CURRENT OF INSULATING MATERIAL.

GUTTA PERCHA, AS IMPORTED.

Genuine, fine and good	1/9 to 2/	per lb.

INDIA RUBBER.

Para, first quality	1/7 to 1/8	„
second „	1/4 to 1/5	„
third Negro-head	1/1 to 1/2	„
Java and Penang	1/2 to 1/4	„

WM. KIRKMANN, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	58 to 63	—
Stock	Electric Telegraph . . .	100	106 to 110	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	$\frac{3}{8}$ to $\frac{5}{8}$	—
5	United Kingdom Telegraph .	3	$1\frac{1}{2}$ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	$1\frac{1}{4}$ to $\frac{3}{4}$ dis.	—

TO CORRESPONDENTS.

IGNORAMUS.—The metre is 3·280899 feet, or 39·37079 inches.

J. H. S.—We know of no special "insulating ink." Bakewell interposed a *varnish* writing between a style and tinfoil in his "copying telegraph." Caselli employs the common ink of commerce in his "pan-telegraph," with a full proportion of gum in it, which is found to insulate sufficiently for the purpose. It should be mentioned that the pressure of the style in the latter instrument is very trifling, it being only a thin platinum wire.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

The *Telegraphic Journal* can be had of Messrs. SMITH & Co., Strand; J. ONWHYN, Catherine-street, Strand; Messrs. DAWSON & Co., Cannon-street, E.C.; Messrs. KENT & Co., Paternoster-row, London. Messrs. HEYWOOD & Co., Manchester; at the various railway stations; and of all news-agents, &c., &c.; or it can be supplied, if preferred, direct from the Office on the following terms:—

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Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

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THE TELEGRAPHIC JOURNAL.

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ON RAILWAY ELECTRIC SIGNALLING.

By W. H. Preece, Assoc. Inst. C.E.

(*Concluded from page 280.*)

There are various places on a double line which require special arrangements differing from the method above described for carrying out the block system. These are junctions, inclines, and mineral sidings. Long tunnels are worked precisely as a single section of the block system.

JUNCTIONS.

The system gradually being introduced on all railways to protect the traffic through junctions, is to maintain the fixed signals at such places always at danger, and not to lower them until a train approaches, or until they are whistled down by the driver, and by combining the points and signals in such a way, that while they work in unison the other signals and points are locked. Thus, when the branch signal is lowered for the admission of a branch train, the main line signals and points are locked, and cannot be altered. It is a system highly conducive to safety, and reflecting great credit upon its inventors and introducers, Messrs. Saxby and Farmer, It was first used on the Brighton line, and is now being gradually introduced on all important railways. It has, however, the great disadvantage common to the "affirmative" system, that the danger signal may be exhibited when no danger really exists, and thus gradually instilling a disregard of its warning on the part of the driver. Now, the advantage of the addition of electric signalling to this system is, that by giving ample warning of the approach of a train, it prevents the unnecessary exhibition of the danger signal. At junctions the electric signals are placed upon the same footing as the fixed signals: they are constantly maintained at danger, and are only lowered on the receipt of the warning signal (Rule 2) when the line be clear. The special instructions at junctions are as follows:—

1. The electric signals are to be always maintained at *Danger*, except when taken off by the junction signalman to admit a train or engine.
2. On the receipt of the signal "Train coming: be ready" (*vide* Rule 2, General Instructions), the junction signalman will, *should the line be clear*, lower the signal for that section to "all clear," but should the line *not* be clear, he will give the obstruction signal on the bell (*vide* Bell Code, No. 5).
3. On the approach or arrival of the train or engine at the station, *provided the electric signal be at "all clear,"* it must be signalled to the junction signal box upon the bell (*vide* Rule 3, General Instructions).
4. The signalman at the junction box will acknowledge this signal by restoring the electric signal to danger, and then, *but not till then*, he will lower his fixed signals.
5. No signal is to be considered complete until it has been acknowledged.

Now, apart from the warning of the approach of the train which is given by the above system, and the consequent preparation made for its passage, the additional security is obtained of a second distant signal at the next station from the junction. Where these stations are far apart, the train can be sent on under the "caution" signal, the driver having been warned of the junction being closed; but, as a rule, junctions are near stations, and there is no necessity for departing from the rule. On a busy and important line it would be advisable to insert an intermediate box if the stations be distant. I have arranged the switches (Fig. 6) of the junction signals so that they lock each other. The movement of one switch from ON to OFF renders the others fixtures. Thus, when the electric signal is lowered for the admission of a branch train, both the up and down main lines are blocked not only at the fixed signals, but on the electric signals also. Under this system the junction is worked as effectively and as safely as any section of the line regulated by the block system. Collisions are impossible, the security of Saxby and Farmer's junction signals is doubled, and *the danger signal is never exhibited except when actual danger exists.*

Of course this system can be applied to junctions whether the line be worked on the block system or not, and upon whatever principle the signals be fixed. It affords a security which no other means of working can possibly supply. Where the block is not used, the above instructions will not apply; but it is only necessary to suppress the warning signal, and slightly modify the other rules, to suit the altered circumstances of the case.

INCLINES

Are worked upon precisely the same system. The signals—electric and out-door—are maintained at "danger;" and permission for trains to descend or ascend is not given until the line is clear, and the signals lowered for that purpose. The instructions framed for this purpose are as follows:—

1. The signals are to be always maintained at *Danger*, except when taken off to admit a train or engine.
2. When a train is ready to descend or ascend the incline, the signalman will signal its approach—"Train coming: be ready" (*vide* No. 9, Bell Code).
3. The signalman at the other end will then, *should the line be clear*, lower the electric signal to "all clear" for the admission of the train; but should the line *not* be clear, he will give the obstruction signal (No. 5, Bell Code).
4. When the line is clear, and the electric signal is lowered, the train will be allowed to proceed, and it will be signalled—"Train in." (No. 2, 3, or 4, Bell Code).
5. The electric signal will then be again restored to danger.
6. No signal must be considered complete until it has been acknowledged.

MINERAL SIDINGS.

One of the most dangerous and complicated points in the management of the traffic on a busy line in the manufacturing and mining districts, is the proper arrangement of the signals at those numerous sidings and junctions with mines, collieries, works, &c., which feed and intercept the main lines at so many spots. It is the custom upon most railways to protect these sidings by distant signals only, and to place these signals at danger before allowing anything to enter or block the main line; but, as under the time system, drivers grow indifferent to the indications of distant signals, cases have occurred where these signals have proved insufficient for the purpose. Fixed standard signals are now being introduced, and all busy sidings are worked precisely as junctions. There are many places, however, where the traffic from the siding is not sufficient to maintain a signalman constantly employed, and where men are temporarily detailed to perform the duty of admitting trains out of and on to the main line. Where the time system is employed, the traffic regular, and such shunting is performed according to the service time tables, it may be conducted with ample security by means of fixed signals; but where the block system is in use, and the traffic is irregular, additional safety is essential. Now, electric signalling offers a ready means to conduct the business of a mineral siding with perfect security. It enables the signalman at the siding, whether permanently employed there or temporarily detailed for shunting duties, to inform the stations on each side of the

siding of the readiness of a train or engine to enter the main line; the signalmen at these stations are thus enabled to block the up or down line, or both, as may be required, and to give permission for the mineral train to leave the siding under perfect protection. The charge of these points are therefore under their supervision, and not under that of the man at the siding, and the safety of the traffic is secured. To do this effectually, it requires a bell communication between the siding and the station on each side, and two semaphores in the siding box—one worked from the one station to protect the down line, and the second worked from the other station to protect the up line. The switches working these semaphores would be locked with the main line switches, so that it would be impossible to lower them together: the "all clear" signal for the train to leave the siding could only be given when the main line signals were blocked. Supposing a train be waiting upon the siding which is upon the down side to enter the down line, the man at the siding would signal upon the bell to the signalman having the protection of the down line—"Down train waiting to come out." This man would then by his bell and semaphore block the down line, and lower the semaphore at the siding for the train to come out. He would maintain the block until the train reached him. Supposing the mineral train were to enter the up line: to do so it would cross both lines, and therefore both lines should be blocked, The man at the siding would signal—"Up train waiting to come out," and the signalmen at each end would block their own lines before permission was given him to come out. That this can be done with ample security and perfect confidence requires no further proof on my part. I cannot give a code of instructions for this particular service, because it would depend so much upon the particular locality and the nature of its traffic, but regulations can easily be framed from the preceding remarks and instructions which have been already given, to suit any point, and meet the emergencies of the traffic at that place.

The next and last point that I shall discuss regarding the adoption of electric signalling into railway working, is the protection it affords to the proper regulation of trains on

SINGLE LINES.

It is in the working of single lines that the application of electricity demands the earnest attention of railway managers. Where more than one engine is employed, the use of the telegraph is rendered compulsory by the Board of Trade. Indeed, it may be said with truth, that this department of Government has devoted more care to the protection of the public in travelling over single lines than to any other branch of railway working. They have issued a most carefully constructed code of regulations for the working of single lines upon the train-staff system; and, it must be admitted, that if this system be regularly adhered to, collisions would be impossible on single lines. But railway managers are at variance not only with the Board of Trade, but with themselves, upon the advantages of the train-staff system. Captain Huish said,* "The only way by which a single line could be worked with absolute safety was by the train-staff." But Mr. Hemans stated, that he had found from experience that it was exceedingly defective, and that when running only four trains per day in each direction on a line of seventy-five miles, that it was next to impossible to repair defects on the line without working in the middle of the night, owing to the difficulty of getting the "train-staff" from passenger trains for the use of ballast trains; and he was convinced that electric signalling, when perfected, must be adopted to develop traffic on single lines. It is perfectly true, as Captain Tyler remarked at the same meeting, that no accident had occurred from trains meeting one another where the staff was employed, but that where telegraph instruments were employed without the staff there had been numerous accidents, in consequence of mistakes and misunderstandings on the part of the persons in charge of the instruments. The principle of the train-staff is undoubtedly sound in theory and conducive to safety; but experience, which, after all, is the true test of theory, has proved it to be impracticable. I know of no long length of single line that is worked by the staff. Mr. Hawkshaw, the then President of the Institution of Civil Engineers, admirably summed up its merits in the following words:—

"Theoretically, no doubt the train-staff led to greater safety than any other mode of working. But persons might be preserved from railway accidents by not going upon a railway at all; and the train-staff was doing away with railway travelling. As a system it simply meant that, provided a company confined itself to one staff, it would also limit itself to one locomotive; and so long as only one locomotive at a time ran upon the line there could not be any collision. But it was obvious that under that system trains could not be started from the same end of the line at short intervals of time; as when the staff was at the other end it must be brought back, and this necessarily involved delay. He considered the train-staff system was wholly inapplicable to any railway on which the traffic was large."

It frequently happened on the Epsom and Leatherhead line of the London and South Western Railway that a man had to be sent on horseback, or by carriage, to the other end of the line to obtain the staff.

It therefore appears that while the train-staff is correct in theory, it fails in practice, and therefore that some other system is required, to give railway managers the security of the train-staff without its disadvantages. Now, the security of the train-staff is this: it renders impossible the collision of two meeting trains upon a single road. If, therefore, we can by any other system render this meeting of two trains equally impossible without the necessity of stopping trains to exchange staves, or delaying trains to wait for the staff, we shall obtain the advantages of the train-staff without its inconveniences.

We obtain this by electric signalling. The security which the block system gives to the traffic of a double line from the danger of the collision of following trains, affords the same protection to single lines from the collision of meeting trains. By means of the electric signal checked by its repeater, a danger signal can be raised at the station in advance, which is not only a protection in itself, but which is a more certain security from accident than the staff. Engine drivers have been known to start without the staff, because they know that no other train can have it before them; but no driver, however reckless he may be, has ever been known to drive a-head in the face of a danger signal on a single line. It is a well known fact, that drivers are far more timid on a single than upon a double line. They know nothing will meet them on a double line, and they always expect to pull up before they come to danger; but on a single line, unless running under a very well regulated system, they lose that recklessness and daring which is so characteristic of them on a double line. I, therefore, contend that there is less fear of the danger signal being disregarded on a single line by a driver than of his proceeding without the staff; and that electric signalling offers a more effective security from the collision of meeting trains on single lines than the train-staff, without any of its inconveniences or delays.

The instructions under which a single line is worked by electric signalling are as follows:—

1. No train or engine is to be allowed to pass your box unless the electric signal for the section into which it is about to proceed stands at ALL CLEAR, and the line has been *blocked* at the station in advance, thus:—

2. On the arrival of a train or engine at your box, you will, provided the electric signal stands at ALL CLEAR, at once signal to the next station in advance—"Train coming." (No. 9 Bell Code.)

* Vide Min. Inst. Civil Engineers, 1862-63, Preece on "Railway Telegraphs."

3. You will then place your switch-handle at ON, thereby placing the electric signal at the station in *advance* at DANGER, and preventing another train from *meeting* that entering the section.

4. The station in advance will, before acknowledging the above signal, put on the danger signals—station and distant—against trains coming in the opposite direction to that from which the train is approaching his station, and keep such signals on till that train arrives, and the section is clear.

5. On receiving the acknowledgment to the above signal the train may enter the section. (No. 2, 3 or 4 Bell Code.)

6. The arrival of the train at the station in advance will be signalled—"Line clear; train out." (Bell Code No. 10.)

7. You will then remove the electric *danger* signal, and clear the line.

8. No signal is to be considered complete until it has been acknowledged.

NOTE.—These signals are not intended to alter or supersede the working arrangements already in use for altering the meeting places, but to prevent (as they will prevent) two trains on a single line meeting each other between any two stations.

It will thus be seen that before a train is allowed to enter a section of line, it is carefully blocked in advance both by the electric and fixed signals, and that under such circumstances the train can proceed with absolute safety. The system admits of no mistake. The signals cannot be completed unless they have acted properly, and until they are completed the train does not move. Trains can follow each other in rapid succession either upon the *space* or the *block* system, for no train can start in the opposite direction until the signals are lowered by the first station. Trains need not be stopped to effect this. When they are not stopping trains, the line is blocked in advance, and cleared for their entry on their being signalled from the previous station. The train-staff cannot do this. It is true that by the aid of tickets and passes following trains can proceed after each other in any number, but the staff which comes last rules supreme, and cannot be given up without delay to allow a train to proceed in the opposite direction. When ballasting trains, specials or irregular traffic occur, the inconvenience is excessive. As the NOTE remarks, the electric signals do not in any way interfere with the existing arrangements for altering the crossing places of trains; on the contrary, they render the system of altering the meeting places doubly secure. All the accidents that have taken place upon single lines, alluded to by Captain Tyler as occurring where the train-staff was neglected, and where the electric telegraph was employed, have arisen from errors or misconceptions in the wording or meaning of the telegrams. On the Shrewsbury and Hereford Railway a collision with loss of life occurred from the insertion of the word "*at*" in the copy of a telegram, and from the general want of explicitness in the wording of the message itself. On a railway in the north of Scotland the superintendent was himself killed in a collision caused by his own irregular orders. On the Monmouthshire Railway a collision occurred from the error of a telegraph clerk in mistaking an ordinary engine for a pilot engine that was expected.

Now, the train-staff or electric signals would have saved all these accidents by protecting the line for the passage of the train from any meeting train, and by affording a secure check from any error in the electric telegraph. Errors in telegrams can only be protected against by adopting additional and independent precautions; and I maintain that electric signalling affords this protection as securely and as completely as the staff, without any of its inconveniences and disadvantages. It is, indeed, the principle of the staff differently carried out.

The use of electric signalling in no way interferes with the general auxiliary character of the telegraph which is so useful in giving notice of the delay of trains, in hurrying on one train and stopping another, in altering as required the authorised passing places, and preventing the unpunctuality of one train from affecting all the rest. It only makes these operations more secure, and renders the effect of any error or misconception in the wording of a telegram harmless and innocent.

I have now completed my description of electric signalling and its various applications to the different requirements of railways. I have confined myself solely to the system I have patented and introduced upon the London and South Western Railway; but my remarks can be applied to most of the systems in use, or perhaps the systems might be applied to my remarks. I believe I have eradicated most of the objections raised against existing systems in the instruments I adopt, but I may have introduced others that I am unaware of. However, I have done my utmost to place electric signalling on its proper footing, and to show railway authorities what a power it affords them to expedite traffic, secure safety, and instil confidence into the mind of the public.

THE ATLANTIC TELEGRAPH.

A CONTEMPORARY, adverting to the Atlantic Telegraph enterprise, makes the following observations as to the progress now being made in the manufacture of the cable, and the arrangements entered into to secure its stowage on board the Great Eastern, and its successful submergence from the hold of that vessel:—

The distance from the western coast of Ireland to the spot in Trinity Bay, Newfoundland, recently selected as the landing-place for the new cable, is a little over 1,600 nautical miles, and the length of cable contracted for to cover this distance, including the "slack," is 2,300 knots, which leaves a margin of 700 knots to cover the inequalities of the sea-bed, and to allow for contingencies. On the first occasion, 2,500 statute miles were taken to sea, the distance to the Newfoundland terminus on that occasion being 1,640 nautical miles; and, after losing 385 miles in 1857, and setting apart a further quantity for experiments upon paying-out machinery, sufficient new cable was manufactured to enable the Niagara and Agamemnon to sail in 1858 with an aggregate of 2,963 statute miles on board the two ships, of which about 450 statute miles were lost in two first attempts of that year, and 2,110 miles were finally laid and worked through.

The greatly increased weight and dimensions of the present cable would have made the question of stowage a very embarrassing one had it not been for the existence of the Great Eastern steamship, there being no two ordinary ships afloat that would be capable of containing, in a form convenient for paying out, the great bulk presented by 2,300 miles of a cable of such dimensions. This bulk, and the now acknowledged necessity for keeping cables continuously in water, have indeed made their influence to be felt in a very expensive manner to the Company and to the contractors throughout the progress of the work even at this early stage. The works at Morden Wharf have had to be to a very large extent remodelled to meet these contingencies Eight enormous tanks, made of five-eighths and half-inch plate iron, perfectly watertight, and very fine specimens of this description of work, have been erected on those premises, into seven of which the cable is now daily being coiled as it comes in its completed state from seven corresponding closing machines. An eighth closing machine will soon be added, and these tanks will then receive an aggregate of 80 miles per week. Four of the tanks are circular in shape, and will each contain 153 miles of cable, being 34 feet in diameter, and 12 feet deep. The other four are slightly elliptical, being 36 feet long by 27 feet wide, and 12 feet deep, and will contain each 140 miles. The contents of all these, as they become full, will have to be transferred to the Great Eastern at Sheerness, and for this service the Lords of the Admiralty have granted the loan of two sailing ships, until recently laid up in ordinary at Chatham, namely, the Amethyst and the Iris. These ships have had to undergo very considerable alteration to render them suitable for the work, portions of the main deck having been removed—fore and aft—to make room for watertight tanks, which here, as elsewhere, are to be the medium for holding the cable. The Amethyst is now ready to receive cable, her two tanks being finished, and the hauling-gear and engine fitted on to her upper deck, ready for coiling it out of the factory. The Iris is in a forward state, and will be ready also in a few days. The dimensions of the two tanks on board the Amethyst are 29 feet diameter by 14 feet 6 inches in depth, and they will each hold 153 miles of cable: of those on the Iris, one will be 29 feet diameter and 14 feet 6 inches deep, and will hold 153 miles, and the other, which will hold 110 miles, will be 24 feet wide and 17 feet deep. The coiling on board the Amethyst will now commence in a few days, and the rate at which the cable can be taken on board her will be about two miles per hour to each tank.

The work on board the Great Eastern steamship is progressing very rapidly. She will contain three very large tanks, one situated in the forehold, one in the afterhold, and the third nearly amidships. The bottoms and the first tier of plates will be of five-eighths iron, and each tank, when completed to this height, is tested as to its tightness by filling it with water, and when found or made to be perfectly watertight, it is let down from its temporary supports on to a bed of Portland cement three inches in thickness, and the building up and riveting of the remaining tiers is continued. The beams beneath each tank are shored up from the floor beneath it down to the kelson with nine inches Baltic baulk timber; and it will give some idea of the magnitude of the work to state that upwards of 300 loads of this material are required for this purpose alone. The dimensions of the fore tank will be 51 feet 6 inches diameter by 20 feet 6 inches in depth, and its capacity is for 693 miles of cable. The middle tank will be 58 feet 6 inches broad, and 20 feet 6 inches deep, and it will hold 899 miles of cable, and the after tank will be 58 feet wide and 20 feet 6 inches deep, and will contain 898 miles. The three tanks are therefore capable of containing in all 2,490 miles of the new cable. The fore tank and the after tank are complete and tested, as high as the first tier of plates, and the erection of the remaining tiers is rapidly progressing. The space is cleared and shored up for the middle tank, and the laying of the iron floor has commenced. It is expected that the Great Eastern will begin to receive cable on board about the first week in January. Her deck engine and hauling-in gear are already prepared, and she will be able to get on board and coil the whole contents of the Iris or the Amethyst within three days from their arrival at Sheerness on each voyage.

The charge of laying the cable on the present occasion will be committed to Mr. Canning and Mr. Clifford, who, in concert with Sir Charles Bright, successfully submerged the original cable in 1858, and whose experience in this branch of engineering has been very large and varied. If all go well, the Great Eastern will be fully loaded and ready for sea by the end of June, 1865, and when fitted completely for this expedition, will have on board about 15,000 tons of cargo, of which the cable will be 4,500 tons, and the coals 8,000 tons; and her complement of hands all told, and including the electrical and engineering staff of the contractors, will be nearly 500 persons. Her commander has not yet been named, but it is to be hoped that no pains or expense will be spared to secure in him and his subordinate officers the very best men that the service can produce. Much will depend upon the manner in which the ship is handled, and as two vast enterprises will, on this occasion, be on their trial at one and the same time, a double responsibility will rest upon the officers to whom the conduct of this remarkable voyage shall be ultimately entrusted.

ON THE ELEMENTARY RELATIONS BETWEEN ELECTRICAL MEASUREMENTS.

By Professor J. Clerk Maxwell and Mr. Fleeming Jenkin.

II.

13. *Measurement of Electric Phenomena by their Electro-magnetic Effects.*—Before treating of electrical measurements, the exact meaning in which the words "quantity," "current," "electromotive force," and "resistance" are used will be explained. But in giving these explanations, we shall assume the reader to be acquainted with the meaning of such expressions as conductor, insulator, voltaic battery, &c.

14. *Meaning of the words "Electric Quantity."*—When two light conducting bodies are connected with the same pole of a voltaic battery, while the other pole is connected with the earth, they may be observed to repel one another. The two poles produce equal and similar effects. When the two bodies are connected with opposite poles, they attract one another. Bodies, when in a condition to exert this peculiar force one on the other, are said to be electrified, or charged with electricity. These words are mere names given to a peculiar condition of matter. If a piece of glass and a piece of resin are rubbed together, the glass will be found to be in the same condition as an insulated body connected with the copper pole of the battery, and the resin in the same condition as the body connected with the zinc pole of the battery. The former is said to be positively, and the latter negatively electrified. The propriety of this antithesis will soon appear. The force with which one electrified body acts on another, even at a constant distance, varies with different circumstances. When the force between the two bodies at a constant distance, and separated by air, is observed to increase, it is said to be due to an increase in the quantity of electricity; and the quantity at any spot is defined as proportional to the force with which it acts through air on some other constant quantity at a distance. If two bodies, charged each with a given quantity of electricity, are incorporated, the single body thus composed will be charged with the sum of the two quantities. It is this fact which justifies the use of the word "quantity."

Thus the quality in virtue of which a body exerts the peculiar force described is called electricity, and its quantity is measured (*cæteris paribus*) by measuring force.

The quantity thus defined produced on two similar balls similarly circumstanced, but connected with opposite poles of a voltaic battery, is equal, but opposite; so that the sum of these two equal and opposite quantities is zero; hence the conception of positive and negative quantities.

In speaking of a quantity of electricity, we need not conceive it as a separate thing, or entity distinct from ponderable matter, any more than in speaking of sound we conceive it as having a distinct existence. Still it is convenient to speak of the intensity or velocity of sound, to avoid tedious circumlocution; and quite similarly we may speak of electricity, without for a moment imagining that any real electric fluid exists.

The laws according to which the force described varies, as the shape of the conductors, their combinations, and their distances are varied, have been established by Coulomb, Poisson, Green, W. Thomson, and others. These will be found accurately described, independently of all hypothesis, in papers by Professor W. Thomson, published in the "Cambridge Mathematical Journal," vol. i. p. 75 (1846), and a series of papers in 1848 and 1849.

15. *Meaning of the words "Electric Current."*—When two balls charged by the opposite poles of a battery, with opposite and equal quantities of electricity, are joined by a conductor, they lose in a very short time their peculiar properties, and assume a neutral condition intermediate between the positive and negative states, exhibiting no electrical symptoms whatever, and hence described as unelectrified, or containing no electricity. But during the first moment of their junction, the conductor is found to possess certain new and peculiar properties: any one part of the conductor exerts a force upon any other part of the conductor; it exerts a force on any magnet in the neighbourhood; and if any part of the conductor be formed by one of those compound bodies called electrolytes, a certain portion of this body will be decomposed. These peculiar effects are said to be due to a current of electricity in the conductor. The positive quantity or excess is conceived as flowing into the deficiency caused by the negative quantity; so that the whole combination is reduced to the neutral condition. This neutral condition is similar to that of the earth where the experiment is tried. If the balls are continually recharged by the battery, and discharged or neutralized by the wire, a rapid succession of the so-called currents will be sent; and it is found that the force with which a magnet is deflected by this rapid succession of currents is proportional (*cæteris paribus*) to the quantity of electricity passed through the conductor or neutralized per second; it is also found that the amount of chemical action, measured by the weights of the bodies decomposed, is proportional to the same quantity. The currents just described are intermittent; but a wire or conductor, used simply to join the two poles of a battery, acquires permanently the same properties as when used to discharge the balls as above with great rapidity; and the greater the rapidity with which the balls are discharged, the more perfect the similarity of the condition of the wire in the two cases. The wire in the latter case is therefore said to convey a permanent current of electricity, the magnitude or strength of which is defined as proportional to the quantity conveyed per second. This definition is expressed by the equation

$$C = \frac{Q}{t}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where C is the current, Q the quantity, and t the time. A permanent current flowing through a wire may be measured by the force which it exerts on a magnet; the actual quantity it conveys may be obtained by comparing this force with the force exerted under otherwise similar conditions, when a known quantity is sent through the same wire by discharges. The strength of a permanent current is found at any one time to be equal in all parts of the conductor. Conductors conveying currents exert a peculiar force one upon another; and during their increase or decrease they produce currents in neighbouring conductors. Similar effects are produced as they approach or recede from neighbouring conductors. [illegible]

laws according to which currents act upon magnets and upon one another will be found in the writings of Ampère and Weber

16. *Meaning of the words "Electro-motive Force."*—Hitherto we have spoken simply of statical effects; but it is found that a current of electricity, as above defined, cannot exist without effecting work or its equivalent. Thus it either heats the conductor, or raises a weight, or magnetizes soft iron, or effects chemical decomposition; in fine, in some shape it effects work, and this work bears a definite relation to the current. Work done presupposes a force in action. The immediate force producing a current, or, in other words, causing the transfer of a certain quantity of electricity, is called an electro-motive force. This force is necessarily assumed as ultimately due to that part of a circuit where a "degradation" or consumption of energy takes place; thus we speak of the electro-motive force of the voltaic or thermo-electric couple; but the term is also used independently of the source of power to express the fact that, however caused, a certain force tending to do work by setting electricity in motion does, under certain circumstances, exist between two points of a conductor, or between two separate bodies. But equal quantities of electricity transferred in a given time do not necessarily or usually produce equal amounts of work; and the electro-motive force between two points, the proximate cause of the work, is defined as proportional to the amount of work done between those points when a given quantity of electricity is transferred from one point to another. Thus, if with equal currents in two distinct conductors the work done in the one is double that done in the second in the same time, the electro-motive force in the first case is said to be double that in the second; but if the work done in two circuits is found strictly proportional to the two currents, the electro-motive force acting on the two currents is said to be the same. Defined in this way, the electro-motive force of a voltaic battery is found to be constant so long as the materials of which it is formed remain in a similar or constant condition. The above definitions, in mathematical language, give $W = E\,C\,t$, or

$$E = \frac{W}{C\,t}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where E is the electro-motive force, and W the work done. Thus the electro-motive force producing a current in a conductor is equal to the ratio between the work done in the unit of time and the current effecting the work. This conception of the relations of work, electro-motive force, current, and quantity will be aided by the following analogy:—A quantity of electricity may be compared to a quantity or given mass of water; currents of water in pipes in which equal quantities passed each spot in equal times would then correspond to equal currents of electricity; electro-motive force would correspond to the head of water producing the current. Thus, if with two pipes conveying equal currents the head forcing the water through the first was double that forcing it through the second, the work done by the water in flowing through the first pipe would necessarily be twice that done by the water in the second pipe; but if twice as much water passed through the first pipe as passed through the second, the work done by water in the first pipe would again be doubled. This corresponds exactly with the increase of work done by the electrical current when the electro-motive force is doubled, and when the quantity is doubled.

Thus, to recapitulate, the quality of a battery or source of electricity, in virtue of which it tends to do work by the transfer of electricity from one point to another, is called its electro-motive force, and this force is measured by measuring the work done during the transfer of a given quantity of electricity between those points. The relations between electro-motive force and work were first fully explained in a paper by Professor W. Thomson on the application of the principle of mechanical effect to the measurement of electro-motive forces published in the "Philosophical Magazine" for December, 1851.

17. *Meaning of the words "Electric Resistance."*—It is found by experiment, that even when the electro-motive force between two points remains constant, so that the work done by the transfer of a given quantity of electricity remains constant, nevertheless, by modifying the material and form of the conductor, this transfer may be made to take place in very different times; or, in other words, currents of very different magnitudes are produced, and very different amounts of work are done, in the unit of time. The quality of the conductor in virtue of which it prevents the performance of more than a certain amount of work in a given time by a given electro-motive force is called its electrical resistance. The resistance of a conductor is therefore inversely proportional to the work done in it when a given electro-motive force is maintained between its two ends; and hence, by equation (5), it is inversely proportional to the currents which will then be produced in the respective conductors. But it is found by experiment that the current produced in any case in any one conductor is simply proportional to the electro-motive force between its ends; hence the ratio $\frac{E}{C}$ will be a constant quantity, to which the resistance as above defined must be proportional, and may with convenience be made equal; thus

$$R = \frac{E}{C}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

an equation expressing Ohm's law. In order to carry on the parallel with the pipes of water, the resistance overcome by the water must be of such nature that twice the quantity of water will flow through any one pipe when twice the head is applied. This would not be the result of a constant mechanical resistance, but of a resistance which increased in direct proportion to the speed of the current; thus the electrical resistance must not be looked on as analogous to a simple mechanical resistance, but rather to a coefficient by which the speed of the current must be multiplied to obtain the whole mechanical resistance. Thus, if the electrical resistance of a conductor be called R, the work, W, is not equal to $C\,R\,t$, but $C \times C\,R \times t$, or

$$W = C^2 R\,t^*, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

where C may be looked on as analogous to a quantity moving at a certain speed, and C R as analogous to the mechanical resistance which it meets with in its progress, and which increases in direct proportion to the quantity conveyed in the unit of time.

18. *Measurement of Electric Currents by their Action on a Magnetic Needle.*—In 1820 Oersted discovered the action of an electric current upon a magnet at a distance, and one method of measurement may be based on this action. Let us suppose the current to be in the circumference of a vertical circle, so that in the upper part it runs from left to right. Then a magnet suspended in the centre of the circle will turn with the end which points to the north away from the observer. This may be taken as the simplest case, as every part of the circuit is at the same distance from the magnet, and tends to turn it the same way. The force is proportional to the moment of the magnet, to the strength of the current as defined by section 15, to its length, and inversely to the square of its distance from the magnet.

Let the moment of the magnet be $m\,l$; the strength of the current, C; the radius of the circle, k; the number of times the current passes round the circle, n; the angle between the axis of the magnet and the plane of the circle, θ; and the moment tending to turn the magnet, G; then

$$G = m\ C \, . \, 2\,\pi\,n\,k\,\frac{1}{k^2}\cos\theta, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

which will be unity if $m\,l$, C, k, and the length of the circuit be unity, and if $\theta = 0^{\circ}$.

The unit of current founded on this relation, and called the electro-magnetic unit, is therefore that current of which the unit of length placed along the circumference of a circle of unit radius produces a unit of magnetic force at the centre.

The usual way of measuring C, the strength of a current, is by making it describe a circle about a magnet, the plane of the circle being vertical and magnetic north and south. Thus, if H be the intensity of the horizontal component of terrestrial magnetism, and G the moment of this on the magnet, $G = m\,l\,H\sin\theta$, whence the strength of the current—

$$C = \frac{k^2}{2\,\pi\,n}\,H\tan\theta, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

where k is the radius of the circle, n the number of turns, H the intensity of the horizontal part of the earth's magnetic force as determined by the usual method, and θ the angle of deviation of the magnet suspended in the centre of the circle. As the strength of the current is proportional to the tangent of the angle θ, an instrument constructed on this plan is called a tangent galvanometer. The instrument called a sine galvanometer may also be used, provided the coil is circular. The equation is similar to that just given, substituting $\sin\theta$ for $\tan\theta$.

To find the dimensions of C, we must consider that what we observe is the force acting between a magnetic pole, m, and a current of given length, L, at a given distance, L_1, and that this force $= \frac{m\,C\,L}{L_1^2}$. Hence the dimensions of C, an electric current thus measured, are $\frac{L^{\frac{1}{2}}\,M^{\frac{1}{2}}}{T}$.

19. *Measurement of Electric Currents by their mutual action on one another.*—Hitherto we have spoken of the measurement of

* By equation (5) we have $W = C\,E\,t$; but by equation (6) $R = \frac{E}{C}$; hence $W = C^2 R\,t$.—Q.E.D.

currents as dependent on their action upon magnets; but this measurement in the same units can as simply be founded on their mutual action upon one another. Ampère has investigated the laws of mechanical action between conductors carrying currents. He has shown that the action of a small closed circuit at a distance is the same as that of a small magnet, provided the axis of the magnet be placed normal to the plane of the circuit, and the moment of the magnet be equal to the product of the current into the area of the circuit which it traverses.

Thus, let two small circuits, having areas A and A_1, be placed at a great distance, D, from each other in such a way that their planes are at right angles to each other, and that the line, D, is in the intersection of the planes. Now let currents C and C_1 circulate in these conductors; a force will act between them tending to make their planes parallel, and the direction of the currents opposite. The moment of this couple will be

$$G = \frac{A\,C \times A_1 C_1}{D^3} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

Hence the unit electric current conducted round two circuits of unit area in vertical planes at right angles to each other, one circuit being at a great distance, D, vertically above the other, will cause a couple to act between the circuits of a magnitude $\frac{1}{D^3}$. The definition of the unit current (identical with the unit founded on the relations given in section 18) might be founded on this action quite independently of the idea of magnetism.

20. *Weber's Electro-Dynamometer.*—The measurement described in the last paragraph is only accurate when D is very great, and therefore the moment to be measured very small. Hence it is better to make the experimental measurements in another form. For this purpose, let a length (l) of wire be made into a circular coil of radius, k; let a length (l_1) of wire be made into a coil of very much smaller radius, k_1. Let the second coil be hung in the centre of the first, the planes being vertical and at the angle θ Then, if a current C traverses both coils, the moment of the force tending to bring them parallel will be

$$G = \tfrac{1}{2} C^2 \frac{l l_1 k_1}{k^3} \sin\theta \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

This force may be measured in mechanical units by the angle through which it turns the suspended coil, the forces called into play by the mechanical arrangements of suspension being known from the construction of the instrument. Weber used a bifilar suspension, by which the weight of the smaller coil was used to resist the moment produced by the action of the currents.

21. *Comparison of the Electro-magnetic and Electro-chemical action of Currents.*—Currents of electricity, when passed through certain compound substances, decompose them; and it is found that, with any given substance, the weight of the body decomposed in a given time is proportional to the strength of the current as already defined with reference to its electro-magnetic effect. The voltameter is an apparatus of this kind, in which water is the substance decomposed. Special precautions have to be taken, in carrying this method of measurement into effect, to prevent variations in the resistance of the circuit, and consequently in the strength of the current.

22. *Magnetic Field near a Current.*—Since a current exerts a force on the pole of a magnet in its neighbourhood, it may be said to produce a magnetic field (section 6), and, by exploring this field with a magnet, we may draw lines of force and equipotential surfaces of the same nature as those already described for magnetic fields caused by the presence of magnets.

When the current is a straight line of indefinite length, like a telegraph wire, a magnetic pole in its neighbourhood is urged by a force tending to turn it round the wire, so that this force is at any point perpendicular to the plane passing through this point and the axis of the current.

The equipotential surfaces are therefore a series of planes passing through the axis of the current, and inclined at equal angles to each other. The number of these planes is $4\pi C$, where C is the strength of the current.

The lines of magnetic force are circles, having their centres in the axis of the current, and their planes perpendicular to it. The intensity of the magnetic force at a distance, k, from the current is the reciprocal of the distance between two equipotential surfaces, which shows the force to be $\frac{2C}{k}$.

The work done on a unit magnetic pole in going completely round the current is $4\pi C$, whatever the path which the pole describes.

AN ELECTRIC ANNUNCIATOR.

In a recent number of the *Scientific American* is published the following description of a new electric annunciator, from the pen of Mr. Thomas Taylor, of Washington. He says:—

"I was invited the other day by a friend to witness a few experiments in the telegraphing line, by means of a very simply-constructed device, and named by the inventor 'Electric Annunciator.' It is on private exhibition at the Smithsonian Institute, Washington, and was constructed and invented by Mr. John Blackie, recently of Scotland. The object of this invention is to enable the pilot of a vessel to communicate with the engineer or helmsman, whereby prompt and efficient orders may be transmitted. One most valuable feature of the device consists in the fact that every movement of the rudder is made known to the pilot or captain in their respective apartments, day or night. The Great Eastern was in the trough of the sea ten hours before the captain was aware that the shaft of the rudder was broken. The value of this instrument may be inferred from the fact that the annunciator would have informed him the moment the accident occurred; for it not only informs the pilot of the captain's wishes, but also communicates the pilot's orders to the engineer and helmsman. Further, it informs the captain whether his orders have been obeyed, the rudder itself giving the information by means of a different galvanometer. When the pilot sends an order he presses a knob and a bell rings, meaning attention. The engineer looks to the index, which resembles a clock face, on which are printed the five general orders used—viz., stop, a-head easy, a-head full speed, back easy, back full speed. The pointer indicates the order, and always remains at the last, and is locked. The device by which the pilot transmits his orders to the engineer is constructed as follows:—First, there is a dial on which the five orders described are printed. A pointer, like the hand of a clock, moves at the will of the pilot from order to order. The pointer is attached to a cylinder of iron four inches and a half long, half an inch diameter, which leads from the centre of the dial backward at right angles, and is supported at each end eccentrically. On each side are two electro-magnets, and one underneath, there being one magnet for each order. A wire from each magnet leads to the pilot-house, and all wires are connected with a battery. By means of five knobs in the pilot-house the connections are made, one on each wire. The iron cylinder or keeper moves from side to side, or downward, according to the attraction of the magnet, and as the pointer is attached to the keeper or cylinder, the movements on the dial will correspond with movements of the keeper, by reason of its eccentric motions. It is stated on good authority that four-fifths of the collisions on our rivers are caused by the present mode of signalizing by bells. The pilot rings to stop, and in an instant he may discover that he should proceed, and rings again, but the two orders are combined in one, and it may be forming one order in itself to the engineer, yet having no relation to the pilot's order, first or last. The prompt action of the engineer increases the confusion, and before it can be rectified a collision takes place. Our late sea fights at Mobile will suggest to any one the necessity of some brief yet more perfect mode of conveying positive information between the commander, pilot, and engineer than ringing a bell. One false move may be the destruction of many lives and much property, and cause terrible disaster to the nation.

"I shall now describe the mode of arrangement by which the captain or pilot may understand the movements of the rudder while in their respective departments. I shall first describe the arrangement of wires, &c., then the mode of attaining results. From the battery to the rudder head a wire is led. From the rudder head to the cabin two wires are led, and from thence to the battery one wire is led and connected. I shall now describe the arrangements in the cabin. Each of the two wires mentioned terminates in a coil, but they are wound up in opposite directions; each coil is placed on the top of the other, and in contact (insulating wire is used), the two ends are left out, and connected here with the third wire which leads to the battery. The coil is of oval form, about four inches and a half long, and two inches wide. A magnetized needle is suspended in the centre; a dial is also used, to which the needle points. This combination forms a differential galvanometer. I shall now describe the combination at the rudder head. A coil of wire like a bell spring, say six inches long and three-eighths of an inch in diameter, connects the two wires alluded to previously, which lead to the cabin. The third wire is connected to a roller which rests on the coil at right angles to it, but this roller is connected with the rudder head in such a manner, that when the

rudder moves from side to side, the roller will move from end to end of the coil, and in contact. The only use of the wire being in coil form is to have a long piece of wire in a short compass. This completes the arrangements. The battery being in action, a current will pass from the battery to the rudder head, conducted by the roller to the coil. If the roller is in the centre the current will split, and one-half go by each wire to the cabin, and as the two coils are wound up in different directions, one current will traverse in one direction and the other in another, but of equal strength. The needle, therefore, will stand perpendicularly. But should the roller move to one end of the coil by a movement of the rudder, the greater part of the current will take the shorter route, and the needle will be deflected, say to the right. A movement to the other end of the coil will cause a deflection to the left for the like reason. It will at once be seen that intermediate movements on the coil will cause corresponding movements of the needle. Thus every movement of the galvanometer indicates every movement of the rudder."

From the foregoing description we are led to conclude that this instrument is very similar in character to Gisborne's ship-steering telegraph.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XIX.

A.D. 1842, November 25.—No. 9528.—Talbot, William Henry Fox.—"Improvements in coating or covering metals with other metals," consisting of:—1st. Preparing metallic surfaces for gilding, by means of a very thin coating of silver, given by immersion in a weak solution of silver in hyposulphite of soda. 2nd. Preparing metallic surfaces for gilding or silvering, by attaching the well-cleaned article "to one of the poles" of a voltaic battery, and plunging both the poles into an acid or saline solution, so as to cause the surface to be gilt to give off hydrogen freely; the article is then "immediately thrown" into a proper solution of gold or silver, and is thereby coated; it is then washed. The process is repeated as often as may be necessary. 3rd. Gilding metallic articles by immersion in a mixed solution containing chloride of gold, mixed with nitrate of lead or hydriodate of zinc. A weak solution of gold is used first, then a strong solution. 4th. "Using a solution of chloride of gold, mixed with a solution of boracic acid, for the purpose of gilding articles of brass or other metal." 5th. When metallic articles "acquire a dark tint," by being dipped into a solution of gold, dipping them into a weak solution of nitrate of mercury, then again into a solution of gold, and so on. The excess of mercury may be removed by an acid, "assisted by voltaic action." 6th. Silvering metallic articles by immersion in different solutions, thus making the metal on the surface become dissimilar to that in solution. A different solution of silver, or of some other metal, may be used. A slight coating is given by voltaic action, "and these dippings are then to be repeated alternately." This method applies to gilding also. "Brass, copper, silver, German silver, iron, and steel," may be coated by the processes described in this specification.

A.D 1842, December 28.—No. 9572.—Hull, Alonzo Grandison.—"Improvements in electrical apparatus for medical purposes, and in the application thereof to the same purposes." The mode in which these improvements are carried into effect is as follows:—"1st. By "making the opposite poles of the electrical circuit of different sizes for the purpose of regulating the quantity, intensity, or quality of the electrical force." 2nd. By "the introduction of medicine into the electrical circuit." 3rd. By "insulated conducting wires for passing the electric current into particular parts of the body." 4th. By "putting particular parts of the body into a positive or negative state of electricity, in order to stimulate, or dissolve, or form it anew." 5th. By "varying the extents of the conducting surfaces, and quantity of water or other fluid, or kind of fluid, or medicine, for the purpose of modifying the electric current." 6th. By "introducing medicine into the body by means of immersion or partial immersion in a bath acted upon by an electrical apparatus." The other points alluded to in the specification are explanatory of the above, and refer also to varying the "conducting power of the water or other media in contact with either pole," also to water or other fluid or medicines or other media," being "the communicating medium between either one or both of the poles and the animal body," and to other means of modifying and applying electrical apparatus to medical purposes.

A.D. 1843, February 21.—No. 9641.—Blackwell, Benjamin Brunton, and Norris, William.—The title of this invention is as follows:—"An improvement in coating iron nails, screws, nuts, bolts, and other articles made of iron with other metals;" and the invention relates to coating iron with copper by galvanic agency. The improvement consists in rendering the iron surface "much less electro-positive to copper, less liable to oxidation, and in a better state for receiving a sound, firm, and ductile coating of copper," either by case-hardening the articles of iron, or by previously coating them with lead or an alloy of lead. The articles may be case-hardened by subjecting them to a red heat in a crucible or iron box, in contact with parings of hoof or horn, or bone dust; the case-hardened surface should be thin, otherwise small articles are liable to be brittle. Articles are coated with lead or its alloys by immersion in the molten metal "in precisely the same manner as is known and practised for covering iron with tin." The alloys of lead that may be used are, lead and tin, and lead, tin, and antimony. The iron goods may be placed (whilst hot from the preparatory process) in a solution of copper, in the galvanic circuit, the battery being kept at 80° or 100° of Fahrenheit's thermometer.

A.D. 1843, April 11.—No. 9698.—Napier, James.—"Preparing and treating fabrics made of fibrous materials," by the electro-deposition of "metal or metals" upon them, so as to make them applicable to "covering roofs," "the bottoms of ships," and other useful purposes. The electric current may be "derived from a galvanic battery or any other source." The invention is described under two heads:—1st. "The preparation of the fabric so as to give it a conducting surface." Any convenient method may be employed; the following methods are described:—The fabric is immersed, and sometimes boiled, in an agitated mixture of plumbago, ground very fine, and water. A pulverized "compound of zinc and iron," mixed with black lead, "is very useful in obtaining a metallic surface." Or "plates or other convenient pieces of metal" are "closely attached to the opposite side of the fabric." Or the fabric is impregnated "with a salt of copper," and glycerine used to reduce such salt. Or the impregnated fabric is exposed to "a current of phosphoretted" [phosphuretted?] "hydrogen and other gases," in a mode described. "Phosphorus dissolved in sulphuret of carbon," "diluted with turpentine," is a reducing agent to be applied to the impregnated fabric "after having been first dipped in the solution of phosphorus." The introduction of "thin metallic wires at intervals into the fabric," is "a method of producing a stronger bond of union between the fabric and the metal." 2nd. The mode of electro-depositing "on fibrous materials." In a vessel containing the depositing solution is placed several sheets of iron, covered on one side with a diaphragm of plaster of Paris and Roman cement, and on the other with the fabric to be deposited on; the whole are then connected by suitable wires so as to form "a galvanic series;" a galvanic battery may be interposed beween the poles to assist the action. Another mode is, to attach the fabric closely to a plate of metal, so as to surround it; paste may be used for this purpose, and the face of the fabric made well conducting; or the fabric may be pasted on to a plate of amalgamated zinc, and the compound of zinc and iron rubbed upon the surface; this is then "placed in a suitable metallic solution," connected properly with a galvanic battery, and the electro-deposition conducted in the usual manner. Or the fabric may be electro-coated in the usual manner, after having its surface made conductable.

A.D. 1843, May 25.—No. 9741.—Pool, Moses (*a communica o*—"Improvements in the deposition of certain metals, and in apparatus connected therewith," consisting "in the employment of certain solutions of gold, silver, and copper," and in the "application of a thermo-electrical battery or apparatus in connection with the same," or other solutions. Silver solution is made by dissolving carbonate of silver (precipitated from the nitrate by carbonate of soda) in a solution of hyposulphite of soda or potash and carbonate of soda; hyposulphite of soda or potash, and carbonate of soda, should be added, so that the solution may contain those salts in the free state. Or, the above solution is boiled "for one hour: during which time a portion of silver is precipitated and the hyposulphite changes, forming a new and distinct salt." Gold solution is made by precipitating "the gold" by "liquor ammoniac" from a solution of gold in nitro-muriatic acid, evaporated "until it assumes a deep red colour," and then diluted: "this precipitate of gold" is dissolved in a solution of "hyposulphite of soda (or potash)" by boiling. Copper solution is made by dissolving car-

bonate of copper in a solution of "hyposulphite of soda (or potash)," and carbonate of soda. The above solutions are used "with currents of electricity." The "thermo-electrical battery" consists of 100 pairs of German silver and iron rods connected together alternately, and placed (insulated from each other) upright in an iron vessel by means of plaster of Paris or clay, but so that all the soldered parts of the series are uncovered. The upper surface is covered with pitch, and has a current of cold water flowing over it; the iron vessel or "frame" is so placed that the lower ends of the series dip into a sand bath "heated nearly to redness." A battery of fifty pairs might suffice for small articles.

A.D. 1843, May 27.—No. 9745.—Bain, Alexander.—"Certain improvements in producing and regulating electric currents, and improvements in electric timepieces, and in electric printing and signal telegraphs," relating to:—1st. "The production of electric currents" by means of one or more positive and negative "substances placed in the earth, or in "natural bodies of water," proper insulated metallic connections being used. 2nd. Regulating voltaic currents. By means of a sliding spindle carrying a pin, the keeper of an adjustable electro-magnet, included in the circuit, stops a clock mechanism, to which the battery plates are attached as a weight whilst the current is sufficiently strong; but when the current weakens, a spring forces the keeper back, and the plates are let down into the solution. Another arrangement:—The plates merely act as the weights to a clock. A third arrangement:—When the current weakens, solution is admitted to the battery by means of a lever and stopper attached to the keeper of an electro-magnet included in the circuit. 3rd. Improvements applied to timepieces and printing or signal telegraphs. Various arrangements, on which the improvements depend, are first set forth; they are as follows:—A rectangular coil of insulated wire is suspended, free to vibrate, between the poles of a permanent horseshoe magnet, or of two horseshoe magnets with opposite poles facing each other, the axis of the coil being at right angles to the axis of the magnet; motion of the coil is produced by the reversal of the direction of the electric current. In another pendulum arrangement, the axis of the coil is parallel to the axis of the magnet; in this case similar poles face each other when two magnets are used. In a third pendulum arrangement, the permanent magnet has a central south pole surrounded by a number of north poles; two magnets, with similar poles facing, may be used. In a fourth arrangement, "a permanent magnet, suspended compass fashion," has two segmental arms free to move through the centres of two coils according to the direction of the electric current; or two semicircular magnets, with similar poles facing, fixed to a brass bar, may be used. The above arrangements are applied to electric clocks in the following manner:—Separate pendulums regulate each other by the third arrangement. The coil is mounted on a spring, and has a catch (included in the circuit) which detains each pendulum until the last has completed the circuit, and enabled the coil to enter the hollow magnet. In another application, a pendulum is worked by means of the first arrangement, one wire being attached to the point of suspension, the other to the axis of an arm carrying a ball on the pendulum, which, by falling from side to side during the vibration of the pendulum, completes and breaks the circuit at proper intervals. In a third application, a pendulum, vibrating according to the third arrangement, is used with the arm and ball movement, the coiled pendulum bob being attracted whenever the circuit is completed through the ball, but not otherwise; in this case the vibration of the pendulum works the clock by means of a click spring and click wheel, or it merely works the escapement, as may be required. A method of working a set of clocks without breaking the main circuit, by a branch circuit returning into the main wire, is set forth. The applications of the electro-magnetic arrangements to printing telegraphs are as follows:—The third arrangement is used to stop governor balls connected with signal and printing apparatus, the current always passing through the coil, except when a signal is made. When the governor balls rotate, they enable one spring barrel to rotate the signal pointer and type wheel, until the hands of both the telegraph instruments (which are alike) point to the desired signal, when another spring barrel is permitted to act on the printing apparatus by means of the governor lever and pallets. The printing apparatus consists of a crank and levers, which move the type wheel up to the paper and the paper roller on its fixed screw axis, by means of a click, click wheel, long pinion, and spur wheel; a blackened ribbon is used to make the characters visible; the dials of both instruments contain ivory studs, which assist their action, and enable the instruments to be adjusted. It is proposed to lay the long conducting wires in grooves (filled with asphalt), in wood pavement, or railway sleepers. A method of "taking copies of surfaces, for instance, the surface of printers' types, at distant places," is described and shown. Somewhat similar apparatus is used at each station; two pendulums regulate each other by the first method herein described in relation to electric clocks, and complete the electric circuit through short insulated wires in a frame in contact with printers' type at the telegraphing station; at the receiving station, the type is copied by the wires, in a series of small dots, on paper moistened with prussiate of potash and nitrate of soda; the type and moistened paper are lowered alike by the action of the electric current in connection with clockwork. A signal telegraph is described and shown, in which the hand points to I or V according to the direction of the current, and is moved by two semicircular magnets, as in the fourth electro-magnetic arrangement. A method of conveying intelligence to police or fire stations is also described and shown. By clockwork, inlaid metal wheels complete and break a circuit the requisite number of times, thus causing a hand at the other stations to indicate the number of the station by the last method herein described in relation to electric clocks.

A.D. 1843, June 15.—No. 9786.—Barratt, Oglethorpe Wakelin.—"Certain improvement in gilding, plating, and coating various metallic surfaces," relating:—

To a voltaic battery for "the deposition of metals," consisting of lead, carbon, and solution of chloride of sodium. "The products of the battery are chloride of lead and caustic soda mixed with carbonate of soda, the value of which products is considerably greater than the expense incurred in the deposition of the metal."

To another battery for the deposition of metals, consisting of zinc, carbon, and water. Fifty cells are recommended for gilding and silvering, and plumbago crucibles may be used as negative plates.

To "obtaining electricity continuously from the magnet" for the deposition of metals. "An electrical-magnetic battery, or battery of magnets," is made by fixing firmly in wood any number of magnets, and forming a continuous metallic circuit, by connecting opposite magnetic poles by means of iron wire. The north pole of the first magnet must be connected with the work to be coated by a copper wire, and the south pole of the last magnet is connected to the dissolving plate by an iron wire. Rotary motion is not required in this arrangement to evolve electricity.

To "the dissolving of the metals." An aqueous solution of "nitrate of potash, chloride of sodium, and sulphate of alumina and potash," is made, and the metal is dissolved in it by suitable battery arrangements until a proper deposit is obtained. The other solvent solutions that may be used are:—For silver, "chloride of sodium or hyposulphite of soda, or cyanide of potassium;" for "gold, platinum, lead, silver, paladium, and other metals," chloride of sodium and boracic acid, or chloride of sodium and tartaric acid.

A.D. 1843, October 27.—No. 9917.—Hull, Alonzo Grandison.—"Improvements in manufacturing or improving fermented and distilled liquors." These consist in "passing a current of electricity through a current of wine, spirits, beer, or other fermented or distilled liquors by means of an electrical apparatus," in order to improve the quality of the liquor so operated upon by perfecting the fermentation, and thereby giving to the liquor a property similar to that usually acquired by age, and likewise affording a means of separating the acetous part of the liquor from the general mass." A method of effecting this object is given by "inserting the poles of a galvanic battery into the liquor;" the kind of battery to be used, the time of its action on the liquor, and the disposal and size of the poles, are set forth. "The most acid condition of the liquor will always be at the positive pole, and from which any quantity may be drawn in case the acid should be too redundant to be mixed up with the mass."

A.D. 1843, November 9.—No. 9932.—Bush, William.—"Improvements in rendering magnetic needles less prejudicially influenced by local attraction," consisting of "a mode of constructing a marine compass, whereby the local attraction may be centralized in or near the axis of motion of the magnetic needle." The compass bowl has fixed to its under part vertical magnetic bars, "chain, tubes, or other forms of steel or iron, supported by an universal joint;" they "act as a pendulum and conductor," and receive "the magnetism of all the iron which might surround" them. Either a single bar may be placed with either pole uppermost, or tubular magnets may be disposed concentrically with alternate poles uppermost, there being a space between. The outer tubular magnet or collection of magnets are shown concentric with

the needle centre in plan, and the outer casing of these vertical magnetic bars is of brass "to protect the magnetic bars or tubes from corrosion." "Where the barometer is required" the middle magnetic bar "may be removed, "and mercury substituted;" in this case there is a "magnetised steel or iron cistern, connected with the magnetic tube, through which the mercury will ascend, serving also as a balance for the bowl or basin which is supported by it." Magnetic needles are described and shown, with 8, 6, and 4 points, respectively having 4, 3, and 2 similar poles, also one needle with two north poles and one south pole. In this invention the bowl contains a cistern of mercury, in which the "axis of the compass" floats by means of a "float or cork." A hollow cone is "placed under the needle; this cone on its under slide" [side?] "has an agate to receive the upper end of the axis affixed on the float, and on its upper surface it has another agate to receive the lower end of the point," "of the needle; and in case the cone is not used, then the axis affixed in the float receives the magnetic needle, it being provided with a suitable agate to receive the point of the axis."

CORRESPONDENCE.

A HOLIDAY FOR TELEGRAPH CLERKS AT CHRISTMAS TIME.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—Will you kindly use your valuable influence in behalf of the female telegraph clerks of London for a holiday at Christmas? I do not think it at all likely we can get a whole holiday on the Monday, but do think our managers might allow us to close at two o'clock on the Saturday (Christmas Eve), and so give a great many of us the pleasure of helping to make, as well as to eat, our Christmas pudding.—I am, Sir, yours, &c.,

Dec. 12. MARIA ELLINGTON.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir,—I know you are always ready to lend a helping hand when the good of telegraphers is in question, and therefore invite the aid of your valuable journal in obtaining a holiday for a large number of your readers on the Monday following Christmas Day. If our directors will take time by the forelock, they could give due notice that their offices will be closed on the 26th instant from a certain hour in the morning, and no greater difficulties need be apprehended than those experienced by persons who have need of the telegraph on Sunday.

A large number of places of business in the city will suspend operations from Saturday, the 24th instant, at 2 P.M., until Tuesday, the 27th instant. We cannot expect (as servants of the public) so grand a concession as this; but I sincerely hope that our directors will contrive to let us have a few hours with our friends at Christmas-tide.—Believe me to be, &c.,

Telegraph-street, E.C., 13th Dec., 1864. A MORSE CLERK.

To the Editor of the TELEGRAPHIC JOURNAL.

Sir.—Permit me, through the medium of your columns, to invite the attention of directors and managers of telegraph companies to the circumstance that Christmas-day this year falls on a Sunday. Most telegraph clerks enjoy the privilege of one day's rest in seven, and on the occasion in question will sacrifice the holiday for the orderly observance of the holy day. I (speaking for others as well as myself) venture to think that if the managers of the several large telegraph establishments in large towns cannot dispense with the services of the whole of their staffs on Monday, the 26th instant (the day on which the festivities of the season will be most generally indulged this year) that at any rate they could give us a little opportunity for participating in the joys and pleasures of Christmas time by granting a half holiday to a moiety of the establishments on the 24th instant, and a half holiday to the other moiety on the 26th instant.

I am fearful of trespassing too much upon your valuable space, so I will conclude by urging on behalf of this little appeal that "Christmas comes but once a year."—I am, &c,

14th December, 1864. YULE LOG.

CONSTANCY OF DANIELL'S BATTERY.—In order to increase still more the constancy of the Daniell's battery, Father Secchi advises the use of fine sand or of powdered sulphur in the porous cell. He accounts for its action by supposing that when the ordinary liquid alone is used there is greater liability to local action taking place upon the zinc. In a battery, the circuit of which is closed for two minutes every quarter of an hour, the learned Father has used an ordinary piece of commercial sheet zinc, half a millimetre in thickness, which has continued in action for more than six months, without showing the least sign of corrosion. For large elements, instead of porous diaphragms, he uses bags made of course linen cloth, well anointed with a luting of flour and lime. Those who have experienced the difficulty of procuring large porous cells would do well to test these contrivances.

TELEGRAPHIC NEWS.

ELECTRIC TELEGRAPH BETWEEN GREECE AND THE IONIAN ISLANDS.—Our Paris correspondent informs us that a convention has been concluded between the Hellenic Government and Messrs. Newall & Co., of Gateshead-on-Tyne, for the establishment of a line of telegraph to connect Greece and the Ionian Islands.

TELEGRAPH TO INDIA.—By a telegram, received through Mr. Reuter's agency, dated Constantinople, December 9th, we are informed that a convention has been signed between the Porte and Persia for an Indian telegraph line *viâ* Panakian (?) pending the completion of the line to Divanich (?). The service will soon open.

A NEW SUBMARINE CABLE.—A correspondent of the *New Orleans Times*, writing from Fort Gaines on the 29th September, says:—"There is now a fine submarine telegraph cable working between this place and Fort Morgan. It is a good thing, as it lessens the duty of the signal corps, who until recently have had a hard time of it."

FIRE AT A TELEGRAPH WORKS.—On the 9th instant a fire broke out on the premises of Messrs. Reid Brothers, telegraph engineers, Wharf-road, City-road. The fire was discovered by the policeman on duty at the time, who quickly summoned the brigade; and, as a plentiful supply of water was at hand, the flames were confined to the engine-room, the locality in which the fire originated. We are glad to be able to state that business will be carried on as usual by the firm. The damage is fully covered by insurance.

EXTENSION OF THE PNEUMATIC DISPATCH AND TELEGRAPHIC SYSTEMS IN LONDON.—On the 13th instant the entire road traffic between Chancery-lane and the top of Gray's-inn-lane was stopped and diverted round by King's-road and Hatton-garden on the one hand, and Chancery-lane and Castle-street, Holborn, on the other, to enable the contractors and their workmen to excavate the roadway for the laying down of the pneumatic tubes, in continuation of the line from Euston-square. The operations for this purpose are being carried on day and night, with a view to the proposed completion of the line and its opening for traffic to the Post-office before the end of January. The requisite Parliamentary powers having been obtained last Session, it is not intended to wait, as was at first thought desirable, for the construction of the Holborn-valley viaduct, by which means the pneumatic tube would have been carried continuously on a level, but to sink the tube under the Valley from Holborn to Snow-hill, it being perfectly practicable by the atmospheric system to work any ordinary load up or down these inclines. From Snow-hill the line will pass under Newgate-street into the Post-office yard, in St. Martin's-le-Grand, where the city station will be established, the site having been granted by the Post-office authorities. The works will be carried forward with as much rapidity as possible, so that the public traffic may be interfered with and suspended as little as possible. Telegraphic wires are to be laid down simultaneously with the tube, for its safe working from terminus to terminus, and there is to be an intermediate station adjacent to the Inns of Court Hotel, now constructing in Holborn.

ELECTRIC AND INTERNATIONAL DRAMATIC CLUB.—On Thursday evening last a private entertainment was given at the Cabinet Theatre, Liverpool-street, King's-cross, by the members of the above club. The theatre was well filled by the friends of the society. The performance commenced with a *petite* comedy, by C. Dance, Esq, entitled *Advice Gratis.* (Mr. Odbody) Mr. F. Perry; (Mr. Eventide) Mr. F. Tranfield; (Edmund) Mr. J. Pike; (Grimes) Mr. J. Hodges; (Mrs. Eventide) Miss Grosvenor; (Ellen) Miss Annette Hall. This *morceau* was followed by the laughable farce, by T. W. Morton, Esq., of *Done on Both Sides.* (Mr. Whiffles) Mr. F. Perry; (Mr. Brownjohn) Mr. R. J. Garrard; (Mr. Pygmalion Phibbs) Mr. W. Coleman; (Mrs. Whiffles) Mrs. Malcolm; (Lydia Whiffles) Miss Annette Hall. The entertainment concluded with the musical farce, by E. Blanchard, Esq., of *The Artful Dodge.* (Mr. Gregory Grudge) Mr. F. Tranfield; (Timotheus Trundle) Mr. W. Simmons; (Tom Toddle) Mr. Jackson; (The Honourable Fredrick Flamwell Fitz-Fudge) Mr. R. J. Garrard; (Demosthenes Dodge, Esq.) Mr. W. Coleman; (Nudge) Mr. Prest; (Budge) Mr. P. Ellis; (Emily Wilton) Mrs. Malcolm; (Susan Smudge) Miss Grosvenor. It would be invidious to select any of the performers for special commendation, as each character was well sustained. The ladies acted their parts with uncommon grace and confidence. Appearances go a great way now-a-days; and it will be but an act of justice to the fair artistes if we express our conviction that the *costumier* in dressing the pieces sadly neglected his art. Of the most conspicuous characters we may mention that Messrs. Garrard, Coleman, and Perry, elicited warm applause by their several delineations, although it was evident throughout that the pieces had been put upon the stage without sufficient rehearsal.

TELEGRAPHIC GRIEVANCES.—The following letter, complaining of the manner in which the telegraph service between India and England, *viâ* Italy, is conducted, appeared in the columns of the *Times* on the 13th instant:—"London, Dec 12.—Sir,—We inclose copy of telegram as received from India, the 28th ult., addressed to us at 'French Wool-street.' On applying at the office of the Submarine Telegraph Company we were informed that the Italian Government some time ago had discharged their English clerks, and have since been obliged to forbid repetitions, as there were so many required that their lines were quite 'blocked up' with them. We had hopes held out that ours should be an exception, but we have

waited a fortnight without hearing further. We should mention the message is not a cypher. As it is right that the public should know in what manner and under what conditions this important service is carried on, we take the liberty of infringing on your valuable space with a specimen.—We are, Sir, yours obediently, 'H.':—'Thro following giving and deare Servie giving and clewie ware coming to the trial master come his presence indispensable no other oath but to would avail against." Another correspondent writing the *Times* on the 14th instant, observes:—"We have received the following notice from the Submarine Telegraph Company—'Notice, if a receiver of a message has reason to suppose that his message has been incorrectly transmitted, and on that or any other account desires a repetition of it, the company is reluctantly obliged to give notice that, for the future, in conformity with a regulation of the Continental telegraph administrations, he will be required to pay for another message and reply. S. M. Clare, Secretary, 58, Threadneedle-street, London, E.C., Nov., 1864.' We pay annually a very large sum of money to and from Alexandria, and rarely receive one correctly transmitted; and often those received are so unintelligible that we are obliged to apply for a repetition before we can act. It seems that we are now, in addition to the loss and annoyance above stated, to pay for the correction of errors caused by the wrong transmission of our messages by the telegraph clerks. We have lost thousands by delay in the transmission of messages and by the incorrectness of those transmitted, and as we know many are in the same position, we beg to say that we will gladly combine with other respectable firms in testing the liability of the companies regarding these irregularities, and by so doing try to secure something like value for our money.—Yours very truly, Charles Leigh Clare & Co., 1, Mount-street, Manchester."

Russian Telegraphs.—The following description of the actual and prospective arrangements of Russia for the general extension of telegraphic communication, and especially as regards the reported project for a line across Behring's Straits, is from the *London and China Telegraph*:—"From St. Petersburg we learn that Mr. Collins has arrived there from America to negotiate with the Russian Government on the telegraph to connect the two hemispheres. According to the despatch addressed by Mr. Secretary Seward to Mr. Collins, and the project laid before the Congress of the United States, a line of telegraphs is to be constructed from some point in the North-Western States of the Union, or their territory on the Pacific, through British Columbia and the Russian-American possessions, thence by a submarine cable of only thirty miles under Behring's Straits, from Cape Prince of Wales to Cape East, the extreme point of the Asiatic Continent. From this spot it is to be continued by a submarine line under the Gulf of Anadir, thence by land across the neck of the Peninsula of Kamtschatka and round the shores of the sea of Ochotsk to the mouth of the Amoor to join the great Russian line of communication with St. Petersburg, and thence with the whole of Europe. Partly to correct some mistakes in Mr. Seward's despatch, and partly to rectify some false impressions that have got abroad, the Russian Telegraph Department has just published an official account of the present state of the works. From this it appears that the line from St. Petersburg is open as far as Irkutzk, the seat of Government in Siberia, whence wires have just been put up, and are opened to Kiachta, the last Russian town, close to the frontiers of China. From this point the telegraph will be eventually carried on to the town of Ourga, and thence through Mongolia and the Great Desert of Gobi to Pekin, terminating at Tien-tsin, on the Gulf of Betchili. 'But,' says the report, 'when this extension will be carried into execution is not yet officially decided.' On the other hand, a line hitherto intended for the exclusive use of the Naval Department is being constructed along the right bank of the Amoor, from Charabofka to Nicolayefsk, to be continued by-and-bye up the Ussouri, and thence to the Gulf of Possiet, in the Sea of Japan. In the concession applied for by Mr. Collins, but not yet granted, the Russian Government is required to construct the line from Wershne-Udinsk to a point on the Amoor, to meet the American line. This comprises a distance of 3,000 versts, or 2,000 English miles, and its execution on the part of Russia is made dependent on the funds being subscribed in America, so as to ensure the performance of their part of the contract within a given period of time, to be fixed by mutual consent. Mr. Seward's statement that this line has been commenced, and is going on with activity, appears, therefore, to be erroneous. A long time will probably intervene before the projected telegraphic communication between the Old World and America can be completed by way of Behring's Straits, and if the new Atlantic telegraph cable be successfully laid in the spring, Mr. Collins's plan will be superfluous, and probably fall to the ground."

Telegraphic Lines in Turkey.—The announcement recently published that the Anglo-Indian telegraphic service through Turkey was now in a complete state is anything but correct, notwithstanding that the convention for its working has been signed. I have already informed you of the inefficiency of the whole system, and since that report matters have gone on from bad to worse up to the present moment, when they may be said to be in a deplorable state. As a proof of this I have only to cite the fact of the gross irregularity with which telegrams from this city reach London, and, even when received, the imperfect manner in which they are transmitted. The reason for this is obvious, and may be very briefly stated. In the first place, the Turkish European lines have been allowed to fall into such a defective condition that they now stand in need of thorough repair, which the Administration, with a very erroneous idea of economy, hesitate to undertake; and, in the next place, notwithstanding the strong remonstrance of the director of the European service, all the employés with any experience have been transferred from the European stations, and removed to the Asiatic line, to meet what is expected to be the increased traffic of the new Indian service. As a natural consequence, the inefficiency of the new hands, coupled with the defective state of the wires, renders the communication with Europe as bad as it possibly can be, and holds out anything but an encouraging prospect for the future regularity of our Anglo-Indian telegraphic correspondence. The real source of this unsatisfactory state of things is to be found in the practice of constantly changing the director-general of the service. I have already pointed this out, and alluded to the powerlessness of the then occupant of the post, Debran Bey. He has since been removed, and his place supplied by Agathon Effendi, who appears to be just as much impressed with the insecurity of his position as his predecessor, and consequently does little or nothing towards bringing about any change for the better. The chief of the Anglo-Indian telegraph, Colonel P. Stewart, who has been zealously engaged here for some time past in trying to put matters in proper train, appears to have been thoroughly disgusted with the immense difficulties he has to contend with, and is now laid up seriously ill. He has been very efficiently supported by Lieutenant-Colonel Golsmith and the resident agent for the Indian Government, Mr. W. L. Courteney. All their exertions, however, to put the telegraphic communication on a satisfactory basis must prove of little avail if they cannot succeed in obtaining a radical reform in the Ottoman telegraph administration, or, in the absence of that, in employing experienced persons enough to see that proper steps are taken to ensure something like regularity in the transmission of messages. It is a fact of the utmost importance, and should be made known, that Russia has now for some time had telegraphic communication with India. A Russian line passes direct to Teheran, and from thence there is a line communicating with the Persian Gulf submarine cable. Of course it would be impracticable to make use of this means of sending messages for our Governmental service, but for commercial purposes it might to a certain extent be employed. Whether this may be so or not, the circumstance of Russia having this line at her command is suggestive of serious consideration, and cannot fail to attract attention.—Correspondent of the *Daily Telegraph*.

MISCELLANEA.

The Telegraph Operator.—A man who lives almost exclusively on *tick*.

Preservation of Wood.—The following method is used in Germany for the preservation of wood:—Mix 40 parts of chalk, 40 of resin, 4 of linseed oil, melting them together in an iron pot; then add one part of native oxide of copper, and afterwards with care, 1 part of sulphuric acid. The mixture is applied while hot to the wood by means of a brush, when dry it forms a varnish hard as stone. This method would be extremely applicable to the preservation of telegraph poles, and other wood-work exposed to the destructive influences of air and water.

The Preservation of Iron in Water.—At the last sitting of the Academy of Sciences, M. Becquerel read a paper on the preservation of cast-iron and iron in fresh water. He had previously shown that when a plate of either material was in contact with a zinc plate, not exceeding the 100th part of the surface of the former, the intensity of the derived electrical currents on the protected metal would in sea water diminish as the distance from the point of contact of the two metals increased, but nevertheless so that the protection afforded by these derived currents would still extend to a considerable distance from the said point of contact. In fresh water there are fewer divided currents on the surface of the metal, a fact which M. Becquerel attributes to the difference of conductibility of the two liquids, and the degree of chemical action which each exercises on the zinc.

The Theory of Expansion.—The very first approximate results of Mr. Fairbairn's experiments showed a wide departure from the Marriotte law. Mr. Fairbairn gives the following table of the density of steam at various temperatures as computed from the old formula and as determined by his own observations. The density is stated in the number of times which the volume of steam is greater than the volume of the water from which it was formed:—

Temperature.	Volume of Steam. By Formula.	Volume of Steam. By Experiment.
244°	1,005	896
245°	969	890
257°	790	651
262°	740	640
268°	680	633
270°	660	604
283°	540	490

These experiments of Mr. Fairbairn overthrew the old notions in regard to the density of steam when formed at different pressures, and they determined the real facts in regard to this branch of the subject, but they by no means settled the question of expansion. Steam formed at a temperature of 283° has a volume 490° greater than the water from which it was formed, while steam at 244° has a relative volume of 896°, but whether steam at 283° with a relative volume of 490°, if allowed to expand to a volume of 896° will have a temperature of 244°, with the corresponding [illegible] an unsolved problem.

DEATH OF PROFESSOR SILLIMAN.—Professor Benjamin Silliman died at his residence in New Haven, Connecticut, on Thursday morning, 24th November, aged eighty-four. He has been professor of chemistry in Yale College since 1824. The *American Journal of Science and Arts* (better known as *Silliman's Journal*) was founded by him in 1818.

NEW ALLOY FOR IRON.—At the American Institute Professor Henry read a paper on a new alloy of copper, zinc, and tin, to be mixed with iron, recently patented by Mr. Arnold. It was stated that 5 to 10 per cent. of the mixture added to cast-iron increased the tensile strength of the iron several thousand pounds to the square inch, as proved by tests at the West Point Foundry.

PROFESSOR D. E. HUGHES.—It seems that many inventions are the result of accident. When Hughes invented the printing telegraph improvement, he was endeavouring to contrive a machine for copying extempore music, so that his melodious improvisations might not be lost. Boarding in the same house with him were the well known musical composer, Louis Hart, and the very intelligent telegraph operator, Norbonne M. Booth; one gave him the use of a piano, the other supplied him with electro-magnetic instruments; a printing telegraph instrument was the consequence. Hughes is now living in Europe, enjoying the well-merited fortune which his genius has earned. At the time of his residence in Kentucky, he was twenty-two years of age, a beardless boy in face and stature, and apparently lacking in mental power. His features were careworn; when spoken to he had a constant grin or giggle, not calculated to impress his interlocutor favourably. His ear for music was so acute that he could tell to a semi-tone the note of anything sounded, from a dry stick to a shovel.—*The Telegrapher.*

THE ELECTRIC CURRENTS OF THE EARTH.—M. Matteucci, in a second memoir, has reported to the Academy at Paris the continuation of his researches on the relations which may exist between these currents and atmospheric electricity, and also his verification of the results already obtained by the study of the currents upon lines whose extremities were plunged into the earth at different levels. Our limited space prevents us from giving details of the mode of experimenting, &c. He reports the results which he obtained by operating on telegraphic lines of great length. He worked most successfully on three lines in the valley of Aosta at different levels. The electric currents obtained in spite of much greater resistance, gave currents and fixed deviations much stronger than those observed in previous experiments on a hill near Turin. The experiments were made at very different hours, but the fixed deviation indicated in all cases an ascendant current in the metallic wire, as in the preceding experiments. In a great many cases the needle remained at the same angle of deviation during the whole duration of an experiment, sometimes an hour; but M. Matteucci states that he has also remarked, when there has been no change in the aspect of the sky, a nearly periodical movement in the needle. He says that, in spite of all the inherent difficulties connected with these studies, which should impose on the philosopher very great reserve in his conclusions, he thinks that he may consider the following result as established upon a great number of conformable facts obtained under very different circumstances:—"When a metallic wire is stretched over the earth, and isolated from it, with its extremities communicating with the earth at two points, at different heights, an electric current circulates constantly in the wire, the cause of which can neither be attributed to the chemical actions of the electrodes nor to those of the terrestial layers into which they are plunged. This current is constantly directed to the metallic wire of the highest point, and its intensity is greater in the longest lines, whose difference of level at the extremities is great. The intensity of the current does not sensibly vary with the depth of the cavities into which the electrodes are plunged, and is the same in the wire suspended at several metres from the earth as in the wire in contact with the earth."

THE SCIENCE OF CHEMISTRY.—This science is not only of advantage to agriculture, physics, mineralogy, and medicine, but its phenomena are interesting to all men. The applications of this science are so numerous that there are few circumstances of life in which the chemist does not enjoy the pleasure of seeing its principles exemplified. Most of those facts which habit has led us to view with indifference are interesting phenomena in the eyes of the chemist. Everything instructs and amuses him; nothing is indifferent to him, because nothing is foreign to his pursuits; and nature, no less beautiful in her most minute details than sublime in the disposition of her general laws, appears to display the whole of her magnificence only to the eyes of the chemical philosopher. All material bodies are the subjects of chemical research. The solid and fluid matter composing the terraqueous globe which we inhabit, also air, light, and heat, are subjects proper for the examination of the chemist. The arts of dyeing, bleaching, tanning, glass-making, printing, working metals, &c., are purely chemical. The vegetation of plants and some of the most important functions of animals have been explained upon the principles of chemistry. By means of this science agriculture and gardening have been greatly improved in Britain and other countries. Chemistry directs the labours of the husbandman and the rural economist. In the dairy, milk cannot be kept sweet and fresh, and butter and cheese cannot be made, without skill founded on chemical principles. Cookery and the art of curing and preserving beef, bacon, hams, and all animal and vegitable substances, are entirely chemical. The art of brewing, distilling, and making all sorts of fermented liquors depends upon the principles of chemistry. In medicine and pharmacy great benefits have been derived from the discoveries of chemical philosophers. The chemist resolves bodies into their elementary principles, and he examines their nature and properties when in a detached or simple state. He thus discovers their mutual relation to one another, and can recombine them in proportions different from those in which they were originally united. Hence new and useful compounds may be formed which nature does not produce. But chemistry is not only valuable as an art which supplies many of the wants, comforts, and luxuries of life. Its objects are sublime and beautiful in other senses; for it is intimately connected with most of the phenomena of nature, as clouds, rain, snow, dew, wind, earthquakes, &c.—*American Paper.*

MICROSCOPIC NEWSPAPERS.—The question, what will newspapers come to, with the price of white paper continually advancing, is one which publishers would like to be able to answer satisfactorily to themselves and to the public. Paper is now more than three times the price that it was before the war. Some newspapers put up their prices correspondingly, others diminish their size to meet the increased expenses. The latter resource as a remedy is, vulgarly speaking, "played out," for the newspaper has not a margin to act upon it in the descending scale anything equal to the ascending scale of prices with the paper-maker. A reading public want something larger than a Treasury note for a newspaper, though Treasury notes are considered valuable reading if people only have enough of them and of the right denomination. Intrinsically, paper is becoming, like gold, an article of value; and nobody who has to buy it ever speaks of it contemptuously as "rags," probably because a great deal of it is nothing but straw. The resources of chemical and mechanical art fail to supply a remedy to the publishers' distress; the only one we can think of in this emergency is suggested by a combination of the science of optics and the art of photography. Mr. Langenheim, the ingenious and enterprising photographer, has succeeded in impressing the whole of the Lord's Prayer upon a photographic print scarcely larger than the head of a pin, which, under a microscope, can be so brought out that any person who has eyes can read it. Now we suggest that as paper is so valuable, the "forms," or types as arranged for newspapers, ought to be photographed in the same way, and each purchaser should provide himself with a good magnifying glass, so as to bring the reading out to the right size. This would be such a saving in the consumption of paper that the manufacturers would soon be willing to compromise with the publishers, and let them have paper at a reasonable price. There would be an advantage to the reader as well as to the publisher in this arrangement. By using greater magnifying power, the reader could make the type suit his eyes, and increase it to any reasonable size, removing at once all cause of complaint that the types are too small. Those who are fond of big stories and swelling head lines could magnify them to any size they please, and get the worth of their money in astonishment if not in information. Politicians could give greater emphasis to their big, round expletives when viewed through such a medium: the only drawback would be that their libels upon each other would look so large that they would be ashamed to see them next day staring them in the face. A candidate for office, jealous of the reputation of an opponent, could so diminish his praises, by a skillful application of the glass, that he could see no merit in the individual at all. If the paper manufacturers could be compelled at once to look at their prices through a continually diminishing medium, there might possibly be no necessity for the improvement we have suggested.—*Philadelphia Ledger.*

THE INTRODUCTION OF GUTTA-PERCHA.—The success of the submarine telegraph, which was first demonstrated in 1851, when the deep-sea cable was laid down in the English Channel between Dover and Calais, entirely depended upon a single point. No submarine cable could be used for telegraphic purposes until its insulation was rendered perfect. Only one material was known to possess this insulating property, as being at the same time indestructible by water, and a bad conductor of electricity. This substance was gutta-percha, now so well known to every one in an infinite variety of forms, but which, only twenty years ago, had scarcely been heard of. It was in 1842 that Dr. Montgomery, an assistant surgeon to the Residency at Singapore, sauntered out one day in the neighbourhood of that city. His attention was attracted by a native woodcutter at his work, and the doctor was struck by the appearance of the hatchet which the man was using. It seemed to be both strong and flexible, and did not resemble any substance which the doctor had ever seen employed for that purpose. On questioning the man, he learnt no more than that the mysterious material could be made into any form by dipping it into boiling water till it was heated through, when it became plastic as clay, regaining, however, when cold, its original hardness and rigidity. Struck by these facts, Dr. Montgomery inquired further, and soon discovered what he had suspected, that gutta-percha, like india-rubber, was a gummy substance which oozed out from between the bark and the wood of certain forest trees, and that it could be had in great abundance. The great utility of such a substance in the arts at once presented itself to his mind. He obtained specimens in various stages of preparation, and sent them to the Society of Arts in London. The society subsequently conferred a gold medal upon Dr. Montgomery. But the substance had already been seen in Europe. Even as early as the time of Charles I., the well-known botanist, Tradescart, had brought hither a specimen of this curious product, under the name of mazer-wood, and it had subsequently been often brought to Europe under the general name of india-rubber, in the form of elastic whips, sticks, &c., but had never attracted much attention. It was in the year 1844 that two hundredweight of this new article of commerce was shipped as an experiment from Singapore. The exportation rapidly increased. In the first four years and a half of the

trade 21,598 piculs of gutta-percha, each picul weighing about 133 lbs., were shipped at Singapore, the whole of which were sent to England, with the exception of 15 piculs to the Mauritius, 470 to the continent of Europe, and 922 to the United States. But the rapid growth of the new trade conveys only a faint idea of the commotion it created among the native inhabitants of the Indian Archipelago The jungles of the Johore were the scenes of the earliest gatherings, and they were soon ransacked in every direction by parties of Malays and Chinese, while the indigenous population gave themselves up to the search with a unanimity and zeal only to be equalled by that which made railway jobbers of every man, woman, and child in England about the same time. The knowledge of the article stirring the avidity of gatherers, gradually spread from Singapore northward as far as Penang; eastward to Borneo, where it was found at Brune, Sarawak, and Pontianak on the west coast; at Keti and Passer on the east.

The Aurora Borealis and the Telegraph.—The effect of the aurora borealis on electric telegraph lines is curious. In September, 1851, there was a remarkable aurora which took complete possession of all the telegraph lines in New England, in the United States, and prevented any business being transacted during its continuance. In February, 1852, another instance occurred. Towards evening a heavy blue line appeared upon the paper used by the operators, which gradually increased in size for the space of half a minute, when a flame of fire succeeded to the blue line of sufficient intensity to burn through a dozen thicknesses of the moistened sheets. The current then subsided as gradually as it had come on, until it entirely ceased, and then succeeded by a negative current (which bleached instead of colouring the paper). This gradually increased until it also, in turn, produced its flame of fire, and burned through many thicknesses of the prepared paper. The effect of the aurora borealis, or magnetic storm, appears to be totally unlike that of common or free electricity, with which the atmosphere is charged during a thunderstorm. The electricity evolved during a thunderstorm, as soon as it reaches a conductor, explodes with a spark, and becomes at once dissipated. The other, on the contrary, is of very low tension, remains upon the wires sometimes half a minute, produces magnetism, decomposes chemicals, deflects the needle, and is capable of being used for telegraphic purposes, although, of course, imperfectly. The aurora borealis has in fact been used for transmitting and receiving telegraphic despatches. This almost incredible feat was accomplished in the forenoon of the 2nd September, 1859, between the hours of half-past eight and eleven o'clock, on the wires of the American Telegraph Company between Boston and Portland, and upon other lines in various parts of the country, as described by Mr. G. B. Prescott, the able superintendent of the American telegraph lines. The auroral influence was observed one day upon all the lines running out of the office in Boston, at the hour of commencing business (eight o'clock, A.M.). and it continued so strong up to half-past eight as to prevent any business being done, the ordinary current upon the wires being at times neutralized by the magnetism of the aurora, and at other times so greatly augmented as to render operations impracticable. At this juncture it was suggested that the batteries should be cut off, and the wires simply connected with the earth. The current from the aurora coming in waves of greater or less intensity, there were times, both while the wave was approaching and while it was receding, when the instruments were enabled to work; but the time varying according to the rapidity of the vibrations, whatever business was done upon the wires during these displays had to be accomplished in brief intervals of from a quarter to half a minute duration During one of these intervals, the Boston operator said to the one at Portland, "Please cut off your battery, and let us see if we cannot work with the auroral current alone." The Portland operator replied, "I will do so. Will you do the same?" "I have already done so," was the answer. "We are working with the aid of the aurora alone. How do you receive my writing?" "Very well indeed," responded the operator at Portland; "much better than when the batteries were on; the current is steadier and more reliable. Suppose we continne to work so until the aurora subsides?" "Agreed," replied the Boston operator. "Are you ready for business?" "Yes; go on," was the answer. The Boston operator then commenced sending private despatches. The line was worked in this manner more than two hours, when, the aurora having subsided, the batteries were resumed.

PATENTS.

APPLICATIONS FOR LETTERS PATENT.

3057. C. Oliver, improvements in apparatus for sounding bells on lighthouses, alarm bells on public and private buildings, and for bells in chapels and places of worship.

3074. T. Wood, improvements in means or apparatus for communicating and signalling on railway trains, and for securing the doors of the carriages.

NOTICES TO PROCEED.

1924. M. Woodiefield, improvements in apparatus for communicating between passengers and guards and between guards and engine-drivers on railway trains.

1979. A. Turner, improvements in apparatus for enabling the passengers in a railway train to communicate with the engine-driver and guard, and the guard and driver with each other, while the train is in motion.

2023. J. Dilkes and E. Turner, improvements in apparatus for facilitating communication between passengers, guards, and drivers, travelling by railway trains.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2710. R. C. Robinson, improvements in semaphoric signals applicable to railway carriages.

2868. G. Score and R. W. Sievier, improvements in the means of communication for railway travellers with the guard.

2926. J. S. Gisborne, improvements in mechanical apparatus by which motion can be communicated or transmitted from one place to another, and between different parts of a ship or other structure to exhibit orders, messages, or signals.

2935. R. Wheble, improvements in the means and apparatus for communicating between passengers, guards, and drivers of railway trains.

PATENT SEALED.

1538. W. J. Pughsley, improvements in obtaining sulphuric acid from the refuse of "pickle," used in tin-plate works, and also from sulphate of iron or "green copperas."

PATENTS WHICH HAVE BECOME VOID.

2961. W. Clark, improvements in the construction of parts of electric telegraph bell apparatus, and in apparatus used in making the same.—A communication.

2987. E. C. Shepard, improvements in magneto-electric machines.

3002. P. Spence, improvements in the treatment of ores for the manufacture sulphuric acid, and in apparatus connected therewith, which apparatus is also applicable to the treatment of ores for separating metals therefrom.

PATENT ON WHICH THE STAMP DUTY OF FIFTY POUNDS HAS BEEN PAID, AND DATE OF ITS PRODUCTION FOR CERTIFICATE.

3078. C. F. Varley, improvements in electric telegraphs.—Dec. 9th, 1861.

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	1/9 to 2/	per lb.

India Rubber.

Para, first quality	1/7 to 1/8	„
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third Negro-head	1/1 to 1/2	„
Java and Penang	1/2 to 1/4	„

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	58 to 63	—
Stock	Electric Telegraph . . .	100	108 to 112	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1⅛ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	1¼ to ¾ dis.	—

TO CORRESPONDENTS.

*** We shall feel greatly indebted to our readers, both at home and abroad, for any information which it may be in their power to render with respect to telegraphic progress.

Communications intended for publication must be authenticated by the names and addresses of the writers; not necessarily for insertion.

Letters relating to Advertisements are to be addressed to the Publishers. All other letters and communications to be addressed to the Editor of the *Telegraphic Journal*, 4 & 5, Suffolk-lane, Cannon-street, London, E.C.

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Clerks, assistants, manipulators, and instrument makers, seeking employment, &c., will find the *Telegraphic Journal* a ready means of making known their requirements.

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WHAT IS ELECTRICITY?

Is it not a strange question to ask at this day? Surely we know what it is. It is familiar to us all. In how many ways do we not use it? As messenger, as coast light, as motive power; to plate our spoons, to ring for our servants, to catch our fish, and also catch our thieves; to light our gas, to tell the time, to watch our idle servants. We use it in metallurgy; in the fine arts to cast our medals, vases, and statuary. We use it in surgery and therapeutics. We use it to spring our mines, to fire our torpedoes, and mark our targets, and for many other purposes—so many that no ordinary memory can contain them. Still, what is electricity?

So wonderful is this thing to me, that I have an unquenchable desire to know it face to face. For this purpose I read our authors, who treat learnedly upon it. I read reports of committees and commissioners, who sit and consult, and take evidence upon it. I converse with men who are wondrous learned in the matter, and try to get their notion of what this thing is. Then I try to collect together the sum and substance of all that I have read and talked about it, and try to put all these multifarious notions, or opinions, or guesses, or I know not what, except that they are certainly contradictions one of the other, into some form to be understood by me if possible; but hitherto it has not been possible. First, I am told that there are five or six kinds of electricity, if not more: that there is static electricity, voltaic electricity, magneto electricity, thermo electricity, photo electricity, and I know not what other kind. Then I am told it is all the same—there is only one kind. Still, that does not satisfy me, for I am told by the report of a committee that static electricity is electricity at rest; yet even then it can produce an effect, and what is more puzzling, this same effect is produced at a distance without a nexus, because I am told that the intermediate air is a non-conductor. But even if it were not, that would not help me, for the electricity is said to be at rest; consequently, cannot be conceived to pass across that interspace of air, for if it did, it would not be at rest; yet there is an effect produced, and it is said to be according to the square of the distance. Well, now, I wish that learned committee had made that report square somewhat with our notions of what can and cannot be. Here is a marvel of impossibilities. Electricity a somewhat, which is at rest, yet effects something at a distance, and without a nexus! The report of the sub-committee for finding out a standard of electric resistance says so. From that can you make out what electricity is? Can anything act when it is at rest? Moreover, can it act in a place where it is not, neither itself nor by a nexus? What is to become of the pupil when the teacher's head goes wrong like that?

There is dynamic electricity also as well as static. This dynamic electricity is said to be made up of two fluids, or else of two forces—many authors say fluids; this last report affirms forces, still speaks of them as fluids; but I think all agree that there are two, whether force or fluid. And the one is called positive or plus, or the overmuch, and the other is called negative or minus, or the overlittle, and that the two, when added together, make zero, or nothing. A notable conclusion!

"Out of nothing nothing comes." Now, what is electricity? Is it an idle question after that? But this is not half the difficulty. To return to what is called static electricity, we are told that there are two kinds of it also. The one kind is a something, and the other is a nothing and less, for the two added together make nothing; the two are called positive and negative fluids or forces; they are also called vitreous and resinous electricity—that is to say, what is called positive electricity is excited on glass by it being rubbed, and negative electricity is excited on sealing-wax, and that these two kinds can be isolated, and any portion of either carried away upon a suitable conductor; but if equal portions of the two be added together, then there is no electricity or a state of neutrality. Furthermore, it is stated that the electricity, which is something, can never be excited without that electricity which is less than nothing making its appearance also, and that this extraordinary occurrence takes place through the decomposition of a neutral electricity whose constituents are this something—vitreous, positive fluid, or force; and this less than nothing—resinous, or sealing-waxous, or negative fluid, or force; and that this neutral, neitheral electricity must be zero or nothing, for the two electric fluids or forces when added together make zero or nothing.

Who knows what static electricity is? It is a fluid; it is a force; it is something; it is nothing; it is less than nothing; it is neutral; it is zero; it acts at a distance, and at the same time is at rest; it repels; it attracts; it thrusts without touching; it pulls without any hold. What is there on earth so wonderful as this? or in the heavens above? or in the waters under the earth?

Our learned authors wrote all this, and their disciples repeat it after them, and look so wise, as if they were the mouthpiece of an oracle; and a poor would-be learner like me (if I could only find a teacher) is sneered at as an ignoramus. No, I cannot understand it, if, as it is stated, that the current in a battery flows from zinc to copper, and in the external circuit from copper to zinc; because they say, "Zinc to cable, charge one minute, discharge one minute; copper to cable, charge one minute, discharge one minute, leakage, &c." How can zinc to cable charge it, I wonder, when no current flows out at the zinc, as it is said? Oh, yes; I know that it is said that in this case you charge it with a negative current; and commissions get evidence in such form of words, and sub-committees write reports in such form, and they do not expect to be laughed at. Not they, for they think they are talking most rationally and learnedly. Well, perhaps we are all a little bit touched together, and each thinks the other demented, as is the habit with mad people.

Nevertheless, I have always conceived, and, I think, I have heard some one say so too, that the laws that govern this universe are simple. Yes, and if they be understood, they can be put down in a rational form of words. But where do we find a rational treatise on electricity, a rational chapter—I had almost said, a rational sentence? There may be this last; I do not say there is not. We will say nothing of minutes of evidence, nor reports of sub-committees. These are full of mathematical analytics,—that shows learning; but of the ordinary every-day common sense there is not much. We have a committee, who have been at work these four or five years finding us an "absolute" measure of electrical resistance in "absolute units." At least, they say they either have found these "absolute units," or are going to do it. Absolute! What is an absolute unit, I wonder? I thought all measures were relative; and I think so still. Is "the absolute" going to be

ground out of that machine at King's College, I wonder. A marvellous feat! A fallible machine that, and liable to many errors; but then the theory of that machine is down in algebraic symbols, and it is worked out. All its errors are demonstrated and allowed for. We shall see. I wonder if they expect more or fewer errors in the conclusion than they put in the premises. You can prove what you will, only take care how you state your premises.

I do not find fault with our electricians for not telling us what electricity is. I do not expect that from them yet. But I, with all other students of electricity, I think, have fair cause for complaint in that they write about electricity in contradictions language, which, if it means anything at all, it is impossibilities, absurdities, nonsense. It is sheer impertinence to get themselves called professors and teachers; they clearly do not know any more than we.

INDOCTUS.

ELECTRO MAGNETS.

CONTRIBUTED BY PROFESSOR D. E. HUGHES.

Being desirous of constructing the best possible electro magnet for telegraphic purposes, and several apparently contradictory results having been obtained, I was induced to investigate very closely the *known* and *unknown* laws regarding the subject. From the commencement of these experiments, the necessity was felt of using an electro chronograph, which would give the correct measure of force obtained on the electro magnet with the correct division of time necessary for the current to produce its maximum effect upon the iron cores of the electro magnet.

Upon reflection, I determined upon using my printing telegraph instrument, which, with some slight modifications for this purpose, most admirably suited the purpose desired. By the aid of this instrument, the time necessary for an electro magnet to pass from its minimum to its maximum of force could be accurately obtained, showing also the amount of force obtained during any fraction of this time. The curves of force so obtained show that for all practical purposes the maximum of force would be obtained by a contact of 1-16th of a second, and that this increase of force, if divided in four divisions of time, would be as 8, 4, 2, 1. Divisions of time equalling 1-1000th of a second of time could be accurately obtained, and in the same time a record made of variations of electro magnetic force from one gramme up to 300 grammes. These results are perfectly constant, no matter what form or size of electro magnet or armature, the only difference being in the increase of the curve.

With ten or three elements, with or without external resistance, the time of passing from its minimum to its maximum was invariably the same. For all practical purposes the maximum of effect would be obtained by a length of contact which would equal 1-28th part of a second, and if we allow the same time for discharging the electro magnet, fourteen currents per second can be sent through an electro magnet for telegraphic purposes, producing the maximum of effect. The retardation caused by the induction of a given line should also be deducted from this speed, allowing probably upon a well constructed air line of a speed with maximum effect of ten contacts per second.

The first step in this investigation was to find what amount of resistance of wire on the electro magnet would produce the maximum effect. For this purpose 500 kilometres of line resistance was chosen, having an average loss of two-thirds of the actual current to earth. This loss could be made greater or smaller, in order to represent the actual working of an air line. After numerous experiments it was found that 120 kilometres' resistance, or sixty on each coil, would give the best average results, taking into consideration all the changes that an actual telegraph line has to undergo during different periods of time. The numerous curves obtained from these experiments would be too long to publish here, but we may state that the highest average curves obtained through different losses were always obtained with the coils having sixty kilometres resistance each.

The next step in this inquiry was to find the proper form and size of the iron cores in the coils of the electro magnet, and from the commencement two very important qualities manifested themselves in different bars of iron submitted to trial. It was found that different bars of iron conducted the magnetism produced in a greater or lesser manner, and that the total magnetic result would be directly as the conducting power of the bar of iron. Thus suppose we take bars of soft iron and steel equal in length and diameter, we shall find by placing a natural magnet at one end of the bar, and then observing how much magnetism is conducted to the free end, that the iron bar will support eight times more weight than the steel placed in the same circumstances. Thus we can easily determine the conducting powers of soft iron to be eight times that of tempered steel, and when placed in the electrical coils, the steel bar required eight times the amount of current to produce the same amount of magnetic force at its free poles, thus showing how important it is to choose the softest iron. The annealing of an ordinary iron bar produced eighteen per cent. difference in favour of the annealed bar. All parts, such as the armature, &c., should be perfectly annealed, as the smallest piece of hard iron reduces the results sensibly. Care should also be taken that the fibres of the iron are longitudinally, reducing the results sensibly if they are transversely. For this reason, a drawn iron tube or wire have been generally found superior for the cores; the greatest difference observed was from ten to fifteen per cent.

Another very important quality of iron, and which we believe has not yet been noticed in its connection with electro magnetism, is the power of absorption of the magnetism in iron. This absorption of the magnetism, or, in other words, that in which the magnetism becomes latent is very remarkable in different species of iron, and with the same iron the amount absorbed is directly as the mass. If we lay upon a bar magnet a piece of iron we shall find that the magnet will support less weight than before, and the difference will be exactly as the amount absorbed by the piece of iron on the magnet. If we now place a piece of hard steel of the same size we shall find that the difference in their absorbing powers are not more than one-sixth, and that the iron has absorbed but one-sixth more than the tempered steel, whilst its conducting powers are eight times. Coils were constructed, having for its core a thin tube of iron one centimetre in diameter, six centimetres in length, and one-quarter millimetre in thickness. They were so arranged that tubes of different thickness could be placed inside. The curves of force obtained with different thicknesses of iron core proved completely that the maximum of effect was arrived at when the core possessed a thickness of one and a-half millimetre.

After this point had been reached, the iron having already conducted all the magnetism generated to the poles, the adding of iron produced a diminished effect caused by the absorption of the maximum magnetism already generated, and thus a certain quantity which was conveyed to the poles became absorbed in the unnecessary iron which was added. This experiment was repeated in a variety of ways, with cores of fine iron wire, with solid bars, and with large and small tubes, proving that where the maximum of conducting power with a given force had been obtained by a certain amount of iron, any additional amount would be prejudicial to the result, a certain portion of the magnetism induced then becoming absorbed in the unnecessary iron. As regards the length of coils and bars, the maximum of effect was obtained in every case with six times in length the diameter of the bar.

Supposing a bar of iron several metres in length, and one centimetre in diameter, had separate coils of the same resistance during its whole length with the same power on each coil, no greater effect would arrive at the poles than one coil six centimetres long, simply from the resistance to conduction of the magnetism generated. Thus, it is of the utmost importance before choosing any iron for the cores of an electro magnet to test it for conduction, taking hard tempered cast steel as a standard. With this standard bars of good iron, same diameter, should at eight times the length of tempered steel support the same weight. Tubes of iron were found the best adapted to a telegraphic electro magnet. Whilst having a sufficiently large diameter near the electrical coils, the amount of iron could be regulated so as to have its maximum of conduction with its minimum of absorption.

The results of these experiments show that the amount, as well as the quality, of iron, in a given electro magnet, to be used with a certain resistance, should be carefully studied; and for an electro magnet giving the highest average results, through 300 to 800 kilometres resistance, it was found that the total weight of iron, in cores connecting bar and armature, should be 80 grammes. Experiments were then made to find the best form of armature which would utilize the maximum of effect produced at the poles of the electro magnet. The same phenomena of conduction and absorption was observed in the different armatures. If the armature was too thin, the resistance to conduction was too great. If too large, the magnetism induced became latent, and a proportion was consequently lost to all practical effect.

It has long been known that the true poles of a magnet are situated at a short distance from the extremity, but no attempt has yet been made of putting this knowledge to practical use in the construction and working of electro magnets.

Projections or pole pieces were now added to the electro-magnet, in order to obtain a coincidence of the true poles of the armature with those of the projections, and the result of these experiments were most successful. The forces increasing rapidly as the true poles approached each other, and diminishing when this coincidence was passed. The armature thus shortened, became exceedingly sensitive and rapid in its action, working with a constant effect, and through a much larger variation of current than possible with the ordinary arrangements of armatures. The sensitiveness to feeble currents of the electro magnet thus arranged was very remarkable, one cell being amply sufficient to work the printing telegraph instrument at its ordinary speed of 120 revolutions of the type-wheel, sending five letters per revolution, or 600 letters a minute through a resistance of 1,000 kilometres, with a loss to earth of two-thirds of total current.

With simple resistance, a small piece of zinc and copper placed upon the tongue would work the magnet perfect and regular at 600 contacts per minute, through 1,000 kilometres resistance. On a resistance of 300 kilometres, a piece of gold coin and silver in water would produce sufficient current to produce the same effects. Experiments show that upon a given resistance and battery, and with so great a loss to earth, that the ordinary arrangement of armature, as in the Morse instrument, or a very sensitive galvanometer, could not indicate the slightest passage of current; by simply changing armatures, the instrument would most perfectly, showing strong indications of a current of sufficient strength to be of practical utility, even when the battery power was again reduced one half. Thus, by care in constructing the electro magnets, and adjusting the true poles of the armatures, a telegraphic line could be easily worked, when the current by loss on line had become far too feeble to make the arrangements heretofore used.

The practical results here mentioned were obtained in the application of these principles to my printing telegraph, rendering it thus very sensible to feeble currents, and at the same time allowing the facility of working without adjustment through a range of from 1 to 100 elements. The Morse relay magnet, constructed upon these laws, would, in my opinion, be more sensitive than before; but even then, the high results mentioned here could not be obtained, simply from the armature being acted upon at a certain distance, using only the minimum of force, whilst, in my printing instrument, the armature resting against the poles in a state of rest, the maximum of force is thus always obtained.

The result of these experiments are not theoretical deductions obtained from the laws shown in the foregoing experiments, but these laws are already practically applied in my printing telegraph instrument, as now working upon the most important and longest lines of the telegraphic administration in France.

"UNCLE SAM" IN REPLY TO "CHEROKEE."

I HAVE obtained Noad's 4th edition—which, I am told, is the latest—in order to compare "Cherokee's" quotations (*Telegraphic Journal*, 1st October and 3rd December) with the original.

"Cherokee" says (quoting Noad, I presume), "So that you see Mr. Wheatstone calls f the *electro-motive* force of a battery." But he says no such thing. Allow me to quote what Noad really does say (394). "*Let* F" (he does not use "f" at all) "*denote the actual force of the current*, E *the electro-motive force*."

Again, quoting the formula

$$f = \frac{nE}{\frac{nRD}{S}}$$

he says, "Mr. Wheatstone tells us, as above quoted, that no matter how S varies, the value of f does not vary." Noad and Wheatstone do *not* state this. Wheatstone's first law, "The electro-motive force is in no degree dependent on the dimensions of any of their parts," states that E, the dividend, not F, the quotient, is unaffected by an alteration in the divisor. "Cherokee" makes the verbal law differ from the formula by quoting erroneously and confounding the values of f and E.

I cannot find that Noad mentions the next question, "as to whether a battery will always do more work when the external and internal resistances are equal or not." I cannot, therefore, dispose of this case as summarily as I have done the first by showing what Noad really does say.

"Cherokee" certainly makes the "law" appear absurd, but I have never seen it stated in such a manner as to permit the construction he puts upon it. It is very easy to make any law appear ridiculous, if one is not careful to state it correctly.

Next, I allow at once that Noad states that "a resistance which might weaken to a considerable extent $\frac{E}{R}$ might not sensibly diminish $\frac{nE}{nR}$," and I accept "Cherokee's" criticism and way of stating the law.

Lastly, as to my "grave fault" in changing the value of R to "suit" my "emergencies," I pointed out (5th November) that the change had been made, and asked, "Who is accountable for the confusion?" I now find that Noad is in fault in this particular case.

Those who wish to see the laws of the current clearly stated should read Gavarret's second volume.

ABRIDGMENTS OF SPECIFICATIONS RELATING TO ELECTRICITY AND MAGNETISM, THEIR GENERATION AND APPLICATION.

XX.

A.D. 1843, November 18.—No. 9946.—Wall, Arthur.—"Certain improvements in the manufacture of iron." This invention consists in the use and application of certain "substances, and of the agency of electricity in the manufacture of iron." Either operation may be applied "independently of the other." In the second operation, the metal is subjected, "whilst in a fluid state, and also whilst in the act of congealing or solidification, to a current of electricity," which is caused to traverse as completely as possible throughout the entire "metallic mass." When the metal runs into a mould it may be made to complete the electric circuit, or it may run around or over a wire included in the circuit. Any kind of electricity may be used, but that from a Grove's or Smee's battery is preferred. The current may be transmitted during solidification, and then stopped; or in casting ordnance it may be continued for some time after the metal has entirely solidified. "In applying electricity to iron in a smelting furnace or cupola," one battery pole is inserted at the tap hole, and the other "into the upper and posterior part of the hearth, or in at one of the tuyre holes or apertures," both poles being in contact with the iron. "In applying electricity to the iron in the pudding or balling furnace," a rod connected with one pole is inserted into one part of the fused metal, and a rod connected with the other pole has an insulated handle attached to it, so as to enable it to be moved about; "thus making the electrical current pass through the metal in every possible direction."

A.D. 1843, December 8.—No. 9982.—Schottlaender, Julius.—1st. "Improvements in the deposition of metals by electric agency upon various felted and other fabrics, such as cloth, linen, leather, glass, earthenware, and the like substances, not being themselves conductors of electricity." To cover "linen or other cloth with a surface of metallic copper," it is cemented by the edges to the plumbagoed surface of a copper plate or matrix, and immersed in a solution of sulphate of copper, in connection with a galvanic battery and dissolving plate in the usual manner. The process may be continued until the copper has penetrated to the exterior of the fabric. The cupreous surface given to the material is plain or ornamented, according to the pattern of the matrix. Three apparatus for metallizing a length of fabric are described and shown; one, consisting of a roller immersed in the trough, round which roller the fabric is made to pass slowly. Another, in which sulphate of copper solution is made to drop upon a felted copper roller forming the positive metal, the fabric passing between this and another roller which forms the matrix. A third, in which the fabric is affixed to copper matrices, placed round the sides of a single cell trough containing zinc and salt, and water, in porous cells, and solution of sulphate of copper. Details of working, and relating to other materials to be metallized, are given. 2nd. Improved batteries for generating electricity. The "concentric battery;" cylinders of copper and zinc separated by porous cells, and placed alternately. The "mercurial battery;" "alternate series of copper and mercury, separated by porous diaphragms, and immersed in a solution of sulphate of copper." The "magnetic battery;" "two circular arrangements of horseshoe or other magnets, placed one within the other." The outer circle of

This method is applicable even to those cases in which the electro-motive force to be measured is incapable of maintaining a current. The laws of chemical electrolysis and electro-magnetic induction afford two other indirect methods of estimating electro-motive force in special cases.

29. *Measurement of Electric Resistance.*—We have already stated that the resistance of a conductor is that property in virtue of which it limits the amount of work performed by a given electro-motive force in a given time, and we have shown that it may be measured by the ratio $\frac{E}{C}$ of the electro-motive force between two ends of a conductor to the current maintained by it. The unit resistance is, therefore, that in which the unit electro-motive force produces the unit current, and therefore performs the unit of work in the unit of time. If in any circuit we can measure the current and electro-motive force, or even the ratio of these magnitudes, we should, *ipso facto*, have measured the resistance of the circuit.

30. *Electric Resistance in Electro-magnetic Units is measured by an Absolute Velocity.*—The dimensions of R are found, by comparing those of E and C, to be $\frac{L}{T}$, or those of a simple velocity. This velocity, as was pointed out by Weber, is an absolute velocity in nature, quite independent of the magnitude of the fundamental units in which it is expressed. The following illustration, due to Professor Thomson, will show how a velocity may express a resistance, and also how that expression may be independent of the magnitude of the units of time and space.

Let a wire of any material be bent into an arc of $57\frac{1}{4}°$ with any radius, k. Let this arc be placed in the magnetic meridian of any magnetic field, with a magnet of any strength freely suspended in the centre of the arc. Let two vertical wires or rails, separated by a distance equal to k, be attached to the ends of the arc; and let a cross piece slide along these rails, inducing a current in the arc. Then it may be shown that the speed required to produce a deflection of 45° on the magnet will measure the resistance of the circuit, which is assumed to be constant. This speed will be the same whatever be the value of k, or the intensity of the magnetic field, or the moment of the magnet. In this form the experiment could not be easily carried out; but if a length, l, of wire be taken and rolled into a circular coil at the radius, k, and the distance between the vertical rails be taken equal to $\frac{k^2}{l}$, then, if the resistance of the circuit be the same as in the previous case, the deflection of 45° will be produced by the same velocity in the cross piece, measuring that resistance; or generally, if the distance between the rails be $p\frac{k^2}{l}$, then p times the velocity required to produce the unit deflection (45°) will measure the resistance. The truth of this proposition can easily be established when the laws of magneto-electric induction have been understood.

IMPROVED METHOD OF COMMUNICATION FOR RAILWAY PASSENGERS.

A new and valuable mode of communication between passengers and the guards of a railway train has been designed by Mr. W. H. Preece, C.E., and has been experimentally tried on the London and South-Western line during the past week with great success. In the construction of the apparatus, Mr. Preece has had recourse to both mechanical and electrical appliances, and the result is an easy, cheap, and perfect system of communication, which every traveller would gladly see accepted by the various railway companies. On Friday, December 16th, this unique contrivance was exhibited for the first time at the railway terminus, Southampton. The apparatus was fixed to a first-class carriage, and a connection having been effected with the guard's van by means of electric wires, the efficiency and simplicity of the communication were demonstrated in a most complete and successful manner. The apparatus will be submitted to the authorities in London this day (Saturday), and we have no doubt that its thorough practicability will secure for it their unqualified approval. This is a question which has for some time occupied the most earnest attention of the railway companies, and a committee has been formed by the railway clearing house, consisting of some of the principal railway managers, to report upon the best plan. Upwards of 200 plans have been submitted, none being found equal to the requirements demanded of such a contrivance. In establishing an effective system of communication between passenger and guard, four points are desiderated as necessary to ensure a practical and useful result:—1. The means of creating an alarm must be easily accessible to every passenger. 2. It must have a means of indicating the particular carriage that requires attention which cannot be replaced by the passengers. 3. It must sound a gong or ring an alarum, which must be unmistakeably heard by the guard. 4. The guard must have the power of attracting the attention of the driver from any portion of the train. There are two plans which have met with considerable favour, and have been carefully tried, but with no decided success at present. These are Tattersall's, which has been fitted on one of the South-Western Railway carriages, and Woodiefield's has been tried upon the Great Western line. The former effects the required object by means of mechanical, and the latter by means of electric force. It is considered hopeless to attempt to carry out all the necessary requirements by the aid of mechanical apparatus alone, and it is felt that the only means at the disposal of engineers to enable them to do so at all effectively is the use of electric force, or of mechanical and electric appliances combined. There are many prejudices against the employment of electricity for such useful purposes as ringing an alarum, sounding bells, &c., but these prejudices only exist through ignorance of the real properties of the force. It is imagined that the use of batteries would be attended by great inconvenience and trouble, and would need an undue amount of attention; but batteries are now constructed which require no attention for twelve months. Electricity is a force which is destined to accomplish an immense amount of useful service in our various domestic and public wants, and the better it is understood the more it will be appreciated and used. The new communication which Mr. Preece has designed is carried out by a combination of mechanical and electrical appliances. Immediately above the seats, between the soft padding and the net rack, is fixed an ordinary bell-rope and tassel, which is easily accessible to every passenger in the compartment. Where the compartment is divided into several seats, each seat has a separate pull; but where no division exists, the bell-rope is placed in the centre of the compartment. The motion of this rope by its seizure or strain in the carriage is transferred by wires and pulleys to catches fixed at the two opposite corners of the carriage, which release two semaphore arms that fall and indicate unmistakeably to the guard the particular carriage that requires attention. These semaphore arms are excedingly distinct, and as they fall simultaneously on either side of the carriage in whichever direction the train is going they are instantly observable. They cannot be replaced by any one but the guard, and their fall completes the electric circuit, which sets in motion a bell in the guard's van, or in each van should there be more than one, and which will ring incessantly until the arm is restored to its original position. If, when the guard reaches the carriage which has raised the alarm, he finds it necessary to stop the train, he can, by means of his key, ring a bell on the engine, which will warn the driver that he must stop. Two wires are carried down the train underneath each carriage, the connection being maintained by very ingenious hook and eye couplings. Attempts have been made to adopt the regular couplings of the carriages, but their electrical action is not sufficiently reliable to depend upon their use. The couplings used are very trustworthy, and easily manipulated, and the whole details of the apparatus are as simple in their mode of working as they are cheap in their construction. Two compartments of a carriage have been fitted up on this principle, and the third has an electrical button alone, which rings a bell without exposing any indicator. This is done more to show the practicability of using electricity for such a purpose than to exhibit a complete communicating apparatus between passengers and guard. The semaphore arm is believed to be of itself a sufficient indicator for both night and day use, but it is an easy matter to make it display a red disc at night by means of a lamp. This system is believed to be the best yet introduced. It combines all the advantages of Tattersall's with the additions of Woodiefield's, and carries them out in a simple, mechanical manner, easily and cheaply applied to existing rolling stock. Its introduction would afford a security to railway passengers which is denied to them by the existing system, and the public demand for such protection has been so loud, that if railway companies do not take the matter up, the Legislature undoubtedly will.

THE ATLANTIC CABLE.

A circumstantial account of the commencement of shipping the Atlantic electric telegraph cable, published in an evening paper on the 10th inst., and copied by several of our contemporaries next day, is, though inaccurate in all the particulars, within a fortnight of probable truth as regards the main statement which it contains. The operation of transferring the cable from the factory at East Greenwich to the hulks Amethyst and Iris has not yet been begun; but, if all should go well, the preparations for this important step in the great enterprise may be concluded before New Year's Day. Meanwhile, it is necessary to correct the utterly erroneous report which has appeared on the subject, and which seems to be indebted for its figures to the back numbers of a scientific journal. Those figures in reality represent no more than the prospective calculations of gentlemen superintending the works—that is to say, they refer to possibilities, not to accomplished facts; and in hardly one instance will the actual result verify the account which gravely purports to be a description of what has already been done.

The works of the Telegraph Construction and Maintenance Company, formerly Messrs. Glass & Elliot's, are now the scene of as marvellously delicate a labour as ever yet taxed human intelligence and skill. The engineer and the electrician unite all their finest energies in the accomplishment of an end which must be universally pronounced the triumph of our century; and the combined process of fashioning this wondrous coil,

and testing its uninterrupted conducting powers throughout the entire length, is an affair so complex as to baffle the understanding of any but experts, while even they will be moved to admiration by a sight of the means adopted to ensure a perfect result. Powerful machinery, by which some fourteen miles of the "core," or gutta-percha-coated copper wire, are worked up into cable every day, is not the most important agency; for the tons of material, during manufacture, must undergo the trial of those exquisite instruments over which the man of science bends watchfully hour after hour, ready not only to detect a fault, but to apprise the engineers at what exact distance in the cable it has occurred. Moreover, the necessity of guarding against every slight inadvertence, every possible act of mischief, involves a constant inspection rarely exercised within the walls of a factory. The personal characters of all the workmen, and of the persons employed to cart the large reels of core from the Gutta-percha Works in the City-road to East Greenwich, are the object of rigorous inquiry; and in case of any defect in the cable being found, its exact point can actually and infallibly be identified with the name of the workman responsible for that part of the work.

We shall now endeavour to give, as succinctly as possible, and from data afforded us by inspection of the works as well as by the courtesy of the chiefs of departments, an account of what is doing at Morden Wharf and a factory in its neighbourhood. At this last-named establishment the covering for the core is fabricated from iron wire and Manilla yarn, which is afterwards steeped in a seething compound of tar and gutta-percha. If a section of the perfected cable be examined, it will be found to measure an inch and one-eighth in diameter, the seven conducting wires lying close together in the middle. They are surrounded by layers of gutta-percha, the rings of which may be faintly discerned, though they form a substantial and practically homogenous coating, about a sixth of an inch thick. So far, we have the core, which is supplied from the gutta-percha works in the City-road, before leaving which place it has undergone the same tests which are afterwards applied during the process of covering at East Greenwich. In the section, we shall further perceive that the core is surrounded by a close mass, more than a quarter of an inch thick, in which are ten round spots of metal; in other words, the sectional ends of rod iron wires. In fact, the protecting mass will be found to consist of ten closely-twisted strands of the soaked Manilla yarn, each strand having iron wire in the middle. It is at the separate factory, then, some hundreds of yards from the closing and coiling machinery at Morden Wharf, that this covering is manufactured, 50 tons of the iron wire being used every week, in combination with Manilla yarn at the rate of 6½ tons a day. The wire is received in coils from Birmingham, and, having been oiled, is stored until wanted; then it is joined very carefully by scarfed ends, or ends cut transversely and fitted together. The machinery by which the Manilla yarn is twisted round the wire is very ingenious, each machine being a long horizontal shaft or spindle, with alternate discs of perforated iron and bobbins of the gold-coloured yarn. In one set of machines the axis of the bobbins is parallel to or identical with the spindle, and the revolution is the same in rapidity as the fixed iron discs; but in an improved series of mechanism above stairs this arrangement is altered, the bobbins being set transversely with the shaft, and revolving very much more slowly. It is, indeed, a curious and rather perplexing sight to observe the difference in the two motions, the discs whirling so rapidly as to render almost invisible the threads of yarn passed eccentrically through the holes, while each thread unwinds itself in the coolest and most leisurely way from the bobbin. These machines will turn out 140 miles of Manilla-covered wire in a day. As it is twisted it goes through the hot solution above-mentioned, and it is then passed through a trough of water to cool it. These little details must be noted by the visitor by use of his own eyes; for during the time of his being inside this factory his power of distinguishing the sounds of the human voice, even ~~if conveyed in a shout~~, is in abeyance. The noise of the machinery is, indeed, absolutely deafening, its effect on the drum of the ear being felt for a minute or two after any person unaccustomed to such enormous and indescribable din has left the building.

At the Morden Wharf factory another stage of operations is commenced. Here the core is received on large reels, and is sunk in circular openings, which are then filled up with water. From first to last, we may here observe, the cable is in all its processes of formation at this factory kept in water, that any flaw in the coating may the more quickly be made apparent. For twelve hours the coils of core are subjected to electrical tests, their continuity being ascertained and their complete isolation proved beyond a doubt. Malicious injury to the core in its transit from the Gutta-percha Works to Morden Wharf would thus be defeated in its purpose by prompt detection and remedy. The joining of the ends is, we need hardly say, about the most delicate operation in the whole course of manufacturing the Atlantic or any telegraphic cable; and whenever the electrician proclaims a faulty transmission of the current, the chances are a hundred to one that the flaw will be found in one of the joints.

Before being worked into cable with the ten strands of wire and yarn, the core is wrapped in a twisted fold of jute, which may be just distinguishable in one of those sections that we have already alluded to, and which are in some request as souvenirs. The machinery by which the cable is twined occupies two floors. The closing machines are below, and they consist of large wheels or tables, revolving horizontally, with reels of the several strands so arranged on their margins as to maintain a relatively stationary position, instead of always keeping their axes pointed to the centre of motion. The strands, converging upward towards a small opening in the roof, meet, and are twisted round the jute-covered core, and so form the entire cable, which is conducted over grooved wheels to another and very noteworthy department. A visit to a large brewery is recalled by the appearance of this place, where platforms lead between huge tanks, or what would elsewhere be vats. They are eight in number, four being round and four oval. The round tanks are 34 feet in diameter, and the oval ones measure 36 feet by 27. Their depth is 12 feet, and they are intended as receptacles for the cable, which descends into them from the wheels overhead, and is coiled very neatly by manual labour. Each tank will conveniently hold 140 miles of the cable, but their capacity, if taxed to the utmost, would be found greater by some ten miles or more. A stream of water constantly falls over the edge of each tank, and, percolating the coils of cable finds its way into an open space which is kept clear in the middle, where it rises to a level with the coil. The water tests the efficiency of the protective covering; and the delicately adjusted batteries in the electrician's room, into which the ends of all the cables are led in one bunch, proves the conducting power to be uninfluenced by any penetration from without. A measured force is being continually sent through the wires, and the least defect in the insulation can thus be registered with unfailing accuracy, even to its exact distance and degree. Hitherto the superintendents of this anxious work have been very fortunate; but it has sometimes happened that a great length of cable has had to be uncoiled, the defective joint cut out, and the whole made good. An account is kept of the daily progress, and there were 629 miles completed on Friday evening, to which another 12 miles would have been added by the end of the following short day's work; so that, speaking tolerably "by the card," we may state that the number of miles of finished wire at this time in the tanks at Morden Wharf is 641. The distance from the west coast of Ireland to Trinity Bay, Newfoundland, is 1,640 nautical miles. Two of the eight tanks are nearly full, and will soon be ready for embarkation by the Amethyst and Iris, two ghostly-looking hulks, which lie alongside near the wharf. The decks of these vessels have been knocked about considerably, and in great part got rid of, to make room for tanks in which the cable will be stowed in the same manner as at the factory. The hulks, when laden, will be towed to the Medway, where the Great Eastern is now lying, with three enormous tanks on board, occupying, by comparison with the surrounding bulk, so little space as to deceive experienced eyes as to their actual dimensions. The Iris and the Amethyst have each two tanks on board, the diameter of which is somewhat less than those at Morden Wharf, the depth being greater. They will have to make nine trips to get all the cable alongside the "big ship."

Mr. Canning and Mr. Clifford, under whose control the operations have been conducted at East Greenwich, will accompany their precious charge on board the Great Eastern, and will direct the laying of the cable across the Atlantic Ocean. Our statement of the mileage of perfected cable gives but little idea of the length of all the materials taken separately. For example, to make up the 2,300 miles of cable which, allowing for various contingencies, will be required, 16,000 miles of copper wire are used. The insulating material is equal to an aggregate length of 18,400 miles; the jute, being in ten strands, will extend to 23,000 miles, which will also be the length of the iron wire; and as each wire is separately covered with five twists or strands of yarn, 135,000 miles of the latter will be worked into the cable; making together a length of material which amounts to 215,500 miles. What these figures really signify may be understood by reference to the astronomical fact that the distance of 237,000 miles is that from the earth to the moon.—*Daily Telegraph.*

CORRESPONDENCE.

PROFESSOR HUGHES'S PRINTING TELEGRAPH.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—I notice in the last number of your journal a short account of the invention of my printing telegraph, copied from the *Telegrapher*, ascribing this invention to a "lucky accident." I am sorry to say that the article in question is without the slightest foundation of truth.

In 1850 I first commenced my printing telegraph, being at that time Professor of Natural Sciences in Kentucky, and it required three years constant experiments before the instrument was capable of transmitting a single word.

This instrument has now become of great practical value, but it has become so only by the unremitting attention and constant improvements which, unassisted, I have been able to make during the last fourteen years.

Thus accident has had but little to do in the invention and perfection of this telegraph system.

Sincerely yours,
D. E. HUGHES.

85, Rue Notre Dame des Champs,
Paris, Dec. 19, 1864.

ELECTRICITY APPLIED TO ORGANS.—Mr. Barker, organ builder, Paris, is said to be the inventor of a mode of applying electricity in the construction of organs, so that the largest organ may be played as easily as the piano, and the pipes may be distributed anywhere through a church. This invention is now being applied to a great organ in course of construction for the church of St. Augustin in Paris.

TELEGRAPHIC NEWS.

Professor Hughes's Synchronous Printing Telegraph.—The French Government have now sixty-five of these beautiful instruments in operation. They are also employed on the Italian lines of telegraph from Turin to Naples, Florence, Geneva, Milan, &c. &c.

The Pier at Southport.—This is the longest pier in England, its original length being 1,200 yards, but it has since been extended to 1,700 yards. The original 1,200 yards is traversed by a small tramway, over which carriages are drawn (for the convenience of invalids) by a stationary engine fixed midway on the pier. Electrical bells are being fixed from each end to the engine-house, so as to acquaint the engineer when to start the engine. The bells are being fixed by Mr. B. Boothroyd, of Southport, and are working excellently. The same gentleman has fitted up a number of bells at the Royal Hotel, Southport. The system used is that of M. Bréguet, as used at the Grand Hotel and Louvre at Paris. The system is in admirable working order.

Electricity and the Electric Telegraph.—On Tuesday evening, the 20th instant, a lecture was delivered on the above subject in St. Paul's Schoolroom, Southport, by Mr. William Morton, of the Magnetic Telegraph Company. The Rev. T. J. Clarke in the chair. The lecturer commenced by stating that few inventions had caused so much surprise and delight as the electric telegraph; and although it had almost become a necessity to many of us, but little was popularly known of this wondrous agent. Of the universality of electricity, it was stated that there was as much employed to combine the gases in one drop of water as would, if instantaneously liberated, cause a flash of lightning sufficient to rend the majestic oak or destroy animal life; and that, in fact, electricity was universal, and every science must be exhausted before its limits could be ascertained. The lecturer drew attention to the different arts of telegraphing used by the ancients, and particularly the aerial and semaphore systems. An electro magnet was first introduced,—it was a piece of soft iron in the shape of a horse-shoe, supported on a large wooden stand, and a battery having been attached, a 28-pound weight was held suspended as long as the current was kept on. A thin piece of wire was next attached to a small stand, and a very powerful battery attached, the wire was instantly rendered red hot, and burnt up, and an explosion of gunpowder was also shown by this experiment. The lecturer then gave a description of the component parts of the needle telegraph. He stated that the action of the needle was based upon the principle of Professor Oersted; that a magnetised needle, free to rotate on its centre, when brought near to a wire through which a current of electricity was passing, tended to place itself at right angles to that wire. This was illustrated by a large needle fixed on a stand, and also showed that by reversing the currents the needle could be made to move either to the right or left, at the desire of the operator. A small electrical engine was then exhibited and described, and it was greatly admired, as was also an electrical pump, for pumping water. The lecturer stated that it was almost impossible to state to what purposes electricity might not be applied. The gas having been turned out, the electric light was exhibited. The lecturer stated that it was qualified for lighthouse purposes, and that it was at present in use at Dungeness Lighthouse, and so powerful was it that it could be seen from the coast of France, the distance across being about thirty miles. The different instruments used in telegraphy were next described, and referred particularly to the needle instrument and the registering instrument of Professor Morse, and the bell system of Sir Charles Bright, as used by the Magnetic Telegraph Company; and in order to show the practical working of the bell system, he requested any of the audience to write down a message. Several messages were sent from one end of the room to another, eliciting applause. The lecturer then adverted to the advantage of this instrument. Pieces of submarine cables were now exhibited, and a small length of the Atlantic and other cables described, showing their different construction. The lecturer desired to call attention to the last great cable the Persian Gulf Cable, which was laid this year by Col. Stewart, Sir Charles Bright, Col. Goldsmidt, and others. By the laying of this cable it brought our communication with India to within a few hours, and that in the course of three or four years from now we might expect to have daily telegrams from Hong Kong, Melbourne, Sydney, and Adelaide. The lecturer then described in verse the different uses which were made by the public in using the telegraph. The lecture was listened to throughout with great attention. After firing a salute with a small cannon, a shocking-coil was introduced, when several of the audience joined hands together, and received a shock; this experiment caused much merriment. A vote of thanks having been given to the lecturer for his interesting lecture, and to Mr. B. Boothroyd for his kindness in assisting, the meeting separated at half-past nine o'clock.

Telegraphic Grievances.—The following is an extract from a letter which appeared in the columns of the *Times* on the 17th instant:—" Sir,—We receive on an average eight messages monthly. Those messages consist of summaries of European and American news, and cost us fully £100 per month. Latterly not one of these has reached us but in a mutilated and incoherent state, not merely an incorrect rendering of a word or words, which must at all times and places be looked for, but so carelessly and ignorantly transmitted as to necessitate the striking out frequently of sentences, and occasionally of whole paragraphs, in some instances entirely destroying the value of the entire telegram. Bad as it is to have to pay for repetition, it is infinitely worse to be shut out from it altogether, as we are in Bombay. The wire goes no further than Suez, and in whatever state a message may arrive there so it is sent on. We are no worse off than our neighbours, for we are very frequently called upon to decipher messages equally as unintelligible as our own. Our messages are compiled by Mr. Reuter, and I am assured by that gentleman every effort is used to insure correct transmission. The only way in which this scandalous business can be remedied is by employing English signallers at all the repeating stations on the continent. Until this be done it is hopeless to expect a better state of things. Occasionally messages are detained so long *en route* that they arrive at Suez after the steamer they are intended to catch has sailed. The next 'available opportunity' is the Calcutta boat, by which they are despatched to Point de Galle. A message thus sent manages to precede the next Bombay mail by a couple of days or so, of course utterly useless, the Calcutta boat bringing a week's later news. No refund can be obtained, because the messages reached Bombay quicker than the regular post! It is said the Continental lines are 'blocked' with messages. No doubt they are, and ever will be, if the present system of signalling is continued. Surely, where such vast interests are at stake, something more than suing the company might be attempted. W. Charman, Managing Proprietor of the *Bombay Gazette*."

MISCELLANEA.

British North American Provinces.—In the semi-official terms proposed for the confederation of the provinces of British North America, we are glad to find that the working of the telegraphic system will be left to private enterprise.

Electro-plating by Magneto-electric Machines.—In America several large firms have abandoned the use of magneto-electric machines for electro-plating, and resumed the use of batteries. Mr. Beardslee, of College Point, continues the use of the machines referred to, and considers the cost of steam power for these machines less than that of acids and metals for batteries to do the same work.

THE SONG OF ELECTRICITY.

I am the spirit of light and love;
 To my unseen hand 'tis given
To pencil the radiant clouds above,
 And polish the stars of heav'n.
I scatter the golden rays of fire
 On the horizon far below;
And I deck the skies, where storms expire,
 With a red and dazzling glow.

My being is like a simple thought
 That dwells in a sinless breast;
A tone of music that ne'er was caught,
 A word that was ne'er expressed.
I burn in the bright and burnished halls,
 Where the fountains of sunlight play,
Where the curtain of gold and opal falls
 O'er the scene of the dying day.

Away! away! through the viewless air,
 Stretch forth your iron thread,
For I will not dim my sandals fair,
 With the dust ye tamely tread.
Aye! rear it up on its million piers,
 Let it reach the world around;
And the journey ye make in a hundred years,
 I'll clear at a single bound.—*The Telegrapher*

PRICES CURRENT OF INSULATING MATERIAL.

Gutta Percha, as imported.

Genuine, fine and good	1/9 to 2/	per lb.
India Rubber.		
Para, first quality	1/8 to 1/9	"
second "	1/4 to 1/5	"
third Negro-head	1/2	"
Java and Penang	1/2 to 1/4	"

Wm. Kirkmann, 4, *Howford-buildings, Fenchurch-street.*

TELEGRAPH SHARES.—*Thursday's Quotations.*

Shares.	Companies.	Paid.	Closing Prices.	Business done.
100	British and Irish Magnetic, A.	all	60 to 65	—
Stock	Electric Telegraph . . .	100	108 to 112	—
100	Submarine Telegraph, registered	all	45 to 55	—
all	Do. scrip	all	[illegible] to [illegible]	—
5	United Kingdom Telegraph .	3	1½ to 1 dis.	—
10	Mediterranean Extension Tel. .	all	3 to 4	—
5	London District Telegraph Co..	all	1 to 2	—
20	Telegraph Maintenance Co. .	4	1½ to 1 dis.	—